EPA/ROD/R04-95/250
1995

EPA Superfund
Record of Decision:

HOMESTEAD AIR FORCE BASE
EPA ID: FL7570024037
OU 01
HOMESTEAD AIR FORCE BASE, FL
09/07/1995

Text:

FINAL

RECORD OF DECISION

FOR

OPERABLE UNIT 1
SITE FT-5, FIRE PROTECTION TRAINING AREA NO. 2

HOMESTEAD AIR RESERVE BASE, FLORIDA

May 1995

Prepared for:

U.S. Army Corps of Engineers
Missouri River Division
Omaha District
Omaha, Nebraska

Montgomery Watson
3501 North Causeway Boulevard, Suite 300
Metairie, Louisiana 70002

RECORD OF DECISION

Operable Unit 1, Site FT-5,
Fire Protection Training Area No. 2
Homestead Air Reserve Base
Homestead, Florida
FDEP Facility No. 138521996

May 1995

Montgomery Watson appreciates the opportunity to work for the U.S. Army Corps of Engineers, at the Homestead Air Reserve Base facility in Homestead, Florida. If you have any questions or comments concerning this report, please contact one of the individuals listed below.

Respectfully submitted,

MONTGOMERY WATSON

Randall S. Luwe, P.G.
Project Manager

Jerry D. Gaccetta, P.G.
Project Engineer

TABLE OF CONTENTS

Page

TABLE OF CONTENTS

LIST OF TABLES

LIST OF TABLES

LIST OF FIGURES

Figure No.	Title	Follows Page

Homestead Air Reserve Base, Florida
Operable Unit No. 1
Fire Protection Training Area No. 2

Declaration for the Record of Decision

DECLARATION STATEMENT

FOR THE

RECORD OF DECISION FOR OPERABLE UNIT NO. 1

SITE NAME AND LOCATION

Homestead Air Reserve Base
Homestead, Dade County, Florida

Operable Unit No. 1 - Site FT-5
Fire Protection Training Area No. 2 (former Site FPTA-2)

STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected remedial action for the Fire Protection Training Area No. 2 (Site FT-5), Operable Unit No. 1 (OU-1), at Homestead Air Reserve Base, in Homestead, Florida. The selected remedial action is chosen in accordance with CERCLA, as amended by SARA, and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision document explains the basis for selecting the remedial alternative for this Operable Unit. The information that forms the basis for this remedial action is contained in the administrative record for Site FT-5/OU-1.

The selected alternative for OU-1 is access restriction for groundwater, use restriction for soil, and groundwater monitoring for contaminant migration and attenuation. The State of Florida, the U.S. Environmental Protection Agency (USEPA), and the U.S. Air Force (USAF) concur with the selected remedy presented in this Record of Decision (ROD).

ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response actions selected in this ROD, may present a current or potential threat to public health, welfare, or the environment.

DESCRIPTION OF THE SELECTED REMEDY

The response action selected in this document addresses through access restriction for groundwater and institutional controls the health and environmental threats determined at this site as exposure to soil and groundwater. It also requires zoning restriction by deed and groundwater monitoring.

The major components of the selected remedy include:

- Implementation of deed restrictions or restrictive covenants to limit usage of Site FT-5/OU-1 to prevent schools, playgrounds, hospitals, and residential units from being built at OU-1 to limit exposure to adults and children.
- Eliminate and prevent the practice of continued rubble disposal at the site.
- Restrict the placement of potable water wells into the contaminated groundwater beneath the site.

Two years of semiannual groundwater monitoring followed by review of the site to assess the migration and attenuation of groundwater contaminants.

Five year review to determine whether the site remains protective of human health and the environment and evaluate the need for further action, if required.

STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, complies with federal and state requirements that are legally applicable or relevant and appropriate to remedial action, and is cost effective. This remedy utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable for this site. The use of institutional controls prevents human exposure to the soils and the contaminated groundwater while semiannual groundwater monitoring would track the migration and/or attenuation of groundwater contaminants. However, because treatment of the principal threats at the site were not found to be practicable, this remedy does not satisfy the statutory preference for treatment as a principal element of the remedy. The nature of the risk to human health is minimal; and, with institutional controls, these risks do not pose a threat to human health or the environment. This alternative meets the human health remedial action objectives (RAOs)

by using institutional controls to prevent human exposure to chemicals of concern (COCs) in the soil and groundwater. Therefore, the more cost effective remedial action is being implemented based on evaluation of this risk and potential site usage.

Because this remedy will result in hazardous substances, pollutants, or other contaminants remaining on-site above health-based levels, a review of the remedial action will be conducted within 5 years after commencement of the remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment. The review will be performed every five years there, after.

UNITED STATES AIR FORCE
HOMESTEAD AIR FORCE BASE

By: Date:

Mr. Alan Olsen
Director, HQ AFBCA-DR

Homestead Air Reserve Base, Florida
Operable Unit No. 1
Site FT-5, Fire Protection Training Area No. 2

Decision Summary for the Record of Decision

DECISION SUMMARY

FOR THE

RECORD OF DECISION FOR OPERABLE UNIT NO. 1

1.0 SITE NAME, LOCATION, AND DESCRIPTION

Homestead Air Reserve Base (ARB) (formerly Homestead Air Force Base) is located approximately 25 miles southwest of Miami and 7 miles east of Homestead in Dade County, Florida (Figure 1-1). The main Installation covers approximately 2,916 acres while surrounding area is semi-rural. The majority of the Base is surrounded by agricultural land.
The land surface at Homestead ARB is relatively flat, with elevations ranging from approximately 5 to 10 feet above mean sea level (msl). The Base is surrounded by a canal (Boundary Canal) that discharges into Military Canal and ultimately into Biscayne Bay approximately 2 miles east.

The Biscayne Aquifer underlies the Base and is the sole source aquifer for potable water in Dade County. Within 3 miles of Homestead ARB an estimated 1,600 people obtain drinking water from the Biscayne Aquifer, while 18,000 acres of farmland are irrigated from aquifer wells (USEPA, 1990). All recharge to the aquifer is through rainfall.

Homestead Army Air Field, a predecessor of Homestead Air Reserve Base, was activated in September 1942, when the Caribbean Wing Headquarters took over the air field previously used by Pan American Air Ferries, Inc. The airline had developed the site a few years earlier and used it primarily for pilot training. Prior to that time, the site was undeveloped. Initially operated as a staging facility, the field mission was changed in 1943 to training transport pilots and crews.

In September 1945, a severe hurricane caused extensive damage to the air field. The Base property was then turned over to Dade County and was managed by the Dade County Port

Authority for the next eight years. During this period, the runways were used by crop dusters and the buildings housed a few small industrial and commercial operations.

In 1953, the federal government again acquired the airfield, together with some surrounding property, and rebuilt the Site as a Strategic Air Command (SAC) Base. The Base operated

<IMG SRC 0495250>

under SAC until July 1968, when it was changed to the Tactical Air Command (TAC) and the 4531st Tactical Fighterwing became the new host. The Base was transferred to Headquarters Air Combat Command (HQ/ACC) on June 1, 1992.

In August 1992, Hurricane Andrew struck south Florida causing extensive damage to the Base. The Base was placed on the 1993 Base Realignment and Closure (BRAC) list and slated for realignment with a reduced mission. Air Combat Command departed the Base on March 31, 1994 with Air Force Reservists activated at the Base on April 1, 1994. The 482and Reserve Fighter Wing now occupies approximately 1/3 of the Base with the remaining 2/3 slated for use and oversite by Dade County.

1.1 OPERABLE UNIT NO. 1 DESCRIPTION

Operable Unit 1 (OU-1)/Site FT-5 occupies a general area approximately 11 acres in size and is located in the southwestern portion of Homestead ARB, north of the approach zone to Runway 05 and southwest of taxiway A (Figures 1-2). The Site FT-5/OU-1 area is bordered by Campbell Drive to the west and northwest which is paved and oriented northeast/southwest; an unnamed paved road to the south; and drainage canal to the east and northeast which typically contains water to a depth of one to two feet.

Beginning at the northern end of the site, the drainage canal flows from northwest to southeast for approximately 525 feet. The canal then changes course by ninety degrees and flows from the northeast to the southwest for approximately 780 feet until it reaches the southern boundary of the site. Offsite, the canal turns southward and flows south to the Boundary Canal which is located approximately 700 feet south ot the site area. Remnants of a circular concrete pad are located on the eastern part of the site where the drainage canal forms a right angle.

The site is currently inactive (with respect to fire protection training activities and disposal practices) and consists of an elevated fill/vegetation area, which is approximately 600 ft by 450 ft, located in the southern portion of the site (Figure 1-3). Lithologic logs indicate the fill was approximately three to six feet thick in 1989. The elevated fill area is covered with low vegetation, pine trees, limestone rubble, asphalt, and other construction debris. Because the site is actively used as a rubble fill area by the Facility, the area occupied by the fill has changed since 1989 and is continually changing. There is typically less than two-inches of soil covering the limestone bedrock at the site (exclusive of the fill area). The limestone

<IMG SRC 0495250A>

<IMG SRC 0495250B>

bedrock is generally characterized as highly weathered and is penetrable with a split-spoon formation sampler.

A drainage ditch is located south of the site just east of the intersection of the unnamed paved road and the drainage canal bordering the site. This ditch collects runoff from the runway area and flows from southeast to northwest into the drainage canal bordering the site. The Ordnance Storage Area is located approximately 100 feet north of Site FT-5/OU-1 and Taxiway A is located approximately 350-400 feet northeast of the site. In addition, two buildings, 4071 and 4076, are located approximately 150 feet northeast of the drainage canal which borders the upper part of the site (Figure 1-4).

1.2 REGIONAL LAND USE

The area adjacent to Homestead ARB including Site FT-5/OU-1, to the west, east, and south within a half-mile radius is primarily composed of farmland and plant nurseries. Residential areas are located within a half-mile to the north and southwest of the Base. Woodlands are located approximately one-half-mile east of the facility and mangroves and marsh occur adjacent to Biscayne Bay. The Biscayne National Park is located 2 miles east of Homestead ARB; the Everglades National park is located 8 miles west-southwest of the Base; and the Atlantic Ocean is approximately 8 miles east of the Base. OU-1/Site FT-5 is located in a portion of the Base which will remain federal property under the auspices of the 482and Fighter Wing. Due to its proximity to the approach zone to Runway 05 and Taxiway A, development of the site is not likely in the foreseeable future. Although the groundwater at the site is not suitable for potable use, it is still classified as a potable source of drinking water.

1.3 REGIONAL SURFACE HYDROLOGY

Surface hydrology at Homestead ARB, including Site FT-5/OU-1 is controlled by five main factors: 1) relatively impermeable areas covered by runways, buildings, and roads; 2) generally, high infiltration rates through the relatively thin layer of soil cover; 3) flat topography; 4) generally, high infiltration rates through the outcrop locations of the Miami Oolite Formation; and 5) relatively high precipitation rate compared to evapotranspiration rate. Infiltration is considered to be rapid through surfaces of oolite outcrop and areas with a thin soil layer. Infiltration rates are accelerated by fractures within the oolite, as well as naturally occurring solution channels. Precipitation percolates through the relatively thin vadose zone to locally recharge the unconfined aquifer.

<IMG SRC 0495250C>

Natural drainage is limited because the water table occurs at or near land surface. The construction of numerous drainage canals on Homestead ARB has improved surface water drainage and lowered the water table in some areas. Rainfall runoff from within Homestead ARB boundaries is drained via diversion canals to the Boundary Canal.

A drainage divide occurs within the Homestead ARB facility property, running from the northern end of the facility, toward the center. Water in the Boundary Canal flows generally south and east along the western boundary of the property, and south along the eastern boundary, converging at a storm-water reservoir located at the southeastern corner of the Base. Flow out of the storm water reservoir flows into Military Canal, which, in turn, flows east into Biscayne Bay, approximately 2 miles east of the Base. Water movement is typically not visible in the canals in dry weather due to the lowered water table and the very low surface gradient (0.3 feet per mile) that exists at the Base.

1.3.1 Regional Hydrogeologic Setting

The regional hydrogeology in the southeast Florida area consists of two distinct aquifers: the surficial aquifer system which consists of the Biscayne Aquifer and the Grey Limestone

Aquifer, and the lower aquifer, the Floridan Aquifer.

Biscayne Aquifer. The Biscayne Aquifer at Homestead ARB consists of the Miami Oolite, Fort Thompson formation, and the uppermost part of the Tamiami Formation. In general, the most permeable parts of the aquifer lie within the Miami Oolite and the Fort Thompson Formation.

The Biscayne Aquifer underlies all of Dade, Broward, and southeastern Palm Beach Counties. The Biscayne Aquifer is the sole source of potable water a Dade County and is a federally-designated sole-source aquifer pursuant to Section 1425 of the Safe Drinking Water Act (SDWA). The Biscayne Aquifer supplies drinking water to approximately 2.5 million people within local communities. All recharge to the aquifer is derived from local rainfall, part of which is lost to evaporation, transpiration, and runoff.

The Biscayne Aquifer has reported transmissivities ranging from approximately 4 to 8 million gallons per day per foot (mgd/ft) (Allman et al., 1979).

Water-table contours indicate that under natural conditions, groundwater flows southeasterly toward Biscayne Bay. The hydraulic gradient of the aquifer is approximately 0.3 ft/mile. The water table at Homestead ARB generally is encountered within 5 to 6 feet of land surface, but may occur at or near land surface during the wet season (May to October). Fluctuations of groundwater levels and local variations in the direction of groundwater flow are due to several factors: (1)differences in infiltration potential; (2) runoff from paved areas; (3) water-level drawdown near pumping wells; (4) significant but localized differences in lithology (e.g., silt-filled cavities); and (5) drainage effects of canals and water-level control structures.

Floridan Aquifer. Underlying the low-permeability sediments of the Tamiami formation and Hawthorn Group are the formations which constitute the Floridan Aquifer. The Floridan Aquifer is composed of limestone and dolomite. It is under artesian pressure and water levels in deep wells may rise 30 to 40 ft above ground surface. Groundwater within these Miocene and Eocene age formations tends to contain dissolved constituents at levels significantly above those recommended for drinking water. In view of the poor water quality and the depth of water yielding zones (800 to 900 feet below land surface [bls]), the Floridan Aquifer is of limited usefulness as a source of potable water supply in the study area.

1.4 REGIONAL SITE GEOLOGY AND HYDROGEOLOGY

The stratigraphy of the shallow aquifer system as determined from soil borings performed during site investigations by Geraghty & Miller (G&M) indicate debris and fill in the area of the rubble mound approximately three to six feet in thickness. The fill material has been described as a gray to brown sand and silt with a high percentage of asphalt and concrete as well as construction and demolition (C&D) debris. There is typically less than two-inches of soil covering the limestone bedrock which consists of surficial weathered Miami Oolite ranging in depth from 2 to 6 feet bls. The weathered limestone consists of a white to brown semi-consolidated to consolidated oolite limestone. This strata is underlain by consolidated to semi-consolidated oolite and coral limestone interbedded with coarse to fine sand and clayey sand layers and lenses down to the total depth of borings (approximately 40 feet bls).

The Biscayne Aquifer is one of the most transmissive aquifers in the world and it underlies Homestead ARB. A thin vadose zone, nominally less than feet deep, overlays the groundwater table at the site. As previously stated, the aquifer structure is a calcium carbonate matrix. This lithology is know to have natural concentrations of target analyte list (TAL) metals. In descending order by concentration, calcium, aluminum, iron magnesium,

sodium, and potassium can be considered the primary metals of carbonate rock. The other TAL metals occur in trace concentrations, less than 50 milligrams per kilogram (mg/kg). The range and the standard deviations are not provided at this time. It should be expected that, as precipitation infiltration and recharge take place, leaching of metal ions from the weathered vadose zone and shallow unsaturated zone occurs. Regional data collected suggest that concentrations of trace metals can be expected to be the greatest in the shallow portion of the aquifer because of the proximity to the source (i.e., the weathering vadose structure) and the decreasing retention time with decreasing depth of the saturated zone. These observations support a hydrogeologic model in which the shallow portion of the aquifer has a greater horizontal transmissivity than the vertical component during recharge at the site to quantitatively differentiate horizontal and vertical components of the aquifer's hydrologic conductivity. The possible presence of vertical solution zones is well documented in the literature. The site-specific effects have not been fully investigated. Nevertheless, the available data does not lead to the immediate conclusion that this is a necessary task. The conceptual model that shallow groundwater is discharging to ditches provided sufficient detail to arrive at the remedial decision for OU-1/Site FT-5.

2.0 HISTORY AND ENFORCEMENT ACTIVITIES

2.1 OU-1/SITE FT-5 HISTORY

2.1.2 Past Site Usage

The Fire Protection Training Area No. 2 operated from 1955 to 1972. The area was not equipped with a liner or residual fuel collection system and it was not a routine practice to first wet the burn area with water before applying flammable liquids (Engineering-Science, 1983). A variety of materials were burned at the site including JP-4, aviation gas, various contaminated fuels, and waste liquids from base shops (oils, lubricants, solvents, etc.). Extinguishing agents included water, carbon dioxide, aqueous film forming foam, and protein foam. After training activities ceased at the site in 1972, construction debris was disposed of by dumping and spreading it over a portion of the site. A mound of compacted material approximately 3 to 6 feet (ft) above grade, with the dimensions of approximately 600 ft by 450 ft, is present in the southern portion of the site. Aerial photographs examined from 1958, 1962, 1973, and 1983 indicate that several (at least four) fire training pits existed in the location of the elevated fill area and at least one additional fire training pit was located north of the elevated fill area (G&M, 1994).

2.2 BASE ENFORCEMENT HISTORY

2.2.1 CERCLA Regulatory History

The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) established a national program for responding to releases of hazardous substances into the environment. In anticipation of CERCLA, the Department of Defense (DOD) developed the Installation Restoration Program (IRP) for response actions for potential releases of toxic or hazardous substances at DOD facilities. Like the Environmental Protection Agency's (EPA's) Superfund Program, the IRP follows the procedures of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). Homestead ARB was already engaged in the IRP program when it was placed on the National Priorities List (NPL) on August 30, 1990. Cleanup of DOD facilities is paid for by the Defense Environmental Restoration Account (DERA), which is DOD's version of Superfund.

The Superfund Amendment and Reauthorization Act (SARA), enacted in 1986, requires federal facilities to follow NCP guidelines. The NCP was amended in 1990 (see 40 CFR 300 et seq.) to implement CERCLA under SARA. In addition, SARA requires greater EPA involvement and oversight of Federal Facility Cleanups. On March 1, 1991, a Federal Facility Agreement (FFA) was signed by Homestead ARB (formerly Homestead AFB), the

USEPA, and the Florida Department of Environmental Protection (FDEP). The FFA guides the remedial design/remedial action (RD/RA)process.

The purpose of the FFA was to establish a procedural framework and schedule for developing, implementing, and monitoring appropriate response actions at Homestead ARB in accordance with existing regulations. The FFA requires the submittal of several primary and secondary documents for each of the operable units at Homestead ARB. This ROD concludes all of the Remedial Investigation/Feasibility Study (RI/FS) requirements for Site FT-5/OU-1 and selects a remedy for Operable Unit No. 1.

As part of the RI/FS process, Homestead ARB has been actively involved in the Installation Restoration Program (IRP) since 1983 and has identified 27 Potential Sources of Contamination (PSCs). Nine sites are in various stages of reporting under the RI/FS stage of CERCLA; ten sites are being investigated in the Preliminary Assessment/Site Investigation (PA/SI) stage of CERCLA, with three of these sites warranting no further investigation; one site has been closed under the Resource Conservation and Recovery Act (RCRA) guidelines: and seven sites are being investigated under the FDEP petroleum contaminated sites criteria (Florida Administrative Code 17-770). Additionally, a RCRA Facility Investigation (RFI) is underway to evaluate numerous solid waste management units (SWMU) identified during a RCRA Facility Assessment (RFA). The following PSCs are currently being investigated according to the CERCLA RI/FS guidelines:

OU-1 -	Fire Protection Training Area 2 (FT-5)
OU-2 -	Residual Pesticide Disposal Area (OT-11)
OU-3 -	PCB Spill C.E. Storage Compound (SS-13)
OU-4 -	Oil Leakage Behind the Motor Pool (SS-8)
OU-5 -	Electroplating Waste Disposal Area (WP-1)
OU-6 -	Aircraft Washrack Area (SS-3)
OU-7 -	Entomology Storage Area (SS-7)
OU-8 -	Fire Protection Training Area 3 (FT-4)
OU-9 -	Boundary Canal/Military Canal (SD-27)

Operable Unit No. 3, PCB Spill C.E. Storage Compounds has been closed out with the No Further Action ROD in June 1994. All other CERCLA sites at Homestead ARB are currently in various phases of the RI/FS process.

2.3 INVESTIGATION HISTORY

2.3.1 IRP Phase I - Record Search

An IRP Phase I - Records Search was performed by Engineering-Science, and is summarized in their report, dated August 1983 (Engineering-Science, 1983). During the Phase I study, sites with the potential for environmental contamination resulting from past waste disposal practices were identified. Thirteen sites of potential concern were identified by reviewing available installation records, interviewing past and present Facility employees, inventorying wastes generated and handling practices, conducting field inspections, and reviewing geologic and hydrogeologic data. In general, Phase I studies are used to determine if a site requires further investigation.

The thirteen sites identified were ranked using the Hazard Assessment Rating Methodology (HARM) developed by JRB Associates of McLean, Virginia, for the USEPA. HARM was later modified for application to the Air Force IRP. The following factors are considered in HARM: (1) the possible receptors of the contaminants; (2) the characteristics of the waste; (3) potential pathways for contaminant migration; and (4) waste management practices. HARM scores for the sites ranked at Homestead ARB ranged from a high of 72 to a low of 7 out of 100. Eight of the thirteen sites were determined to have a moderate-to-high contamination potential, one of which was the Fire Protection Training Area No. 2. Additional monitoring was recommended for these sites. The remaining five sites were determined to have a low potential for environmental contamination.

According to the IRP Phase I Report, Site FT-5/OU-1 received moderate to high HARM score of 66 due to the moderate quantity of liquid wastes used and the high potential for contaminant migration in surface- and groundwaters of the site. Site FT-5/OU-1 scored high as a potential migration pathway because of the extremely permeable nature of the soils and underlying rock in the area and the proximity of the bordering drainage canal. Groundwater samples were collected for analyses of pH, total dissolved solids (TDS), oil and grease, total organic carbon (TOC), phenols, volatile halocarbons, and volatile aromatics.

2.3.2 IRP Phase II - Confirmation/Quantification

An IRP Phase II study was performed by Science Applications International Corporation (SAIC), and was reported on in March 1986 (SAIC, 1986). The objectives of Phase II are to confirm the presence or absence of contamination, to quantify the extent and degree of contamination, and to determine if remedial actions are necessary. During the Phase II study, additional investigations were performed at the eight sites recommended for monitoring in the Phase I report, as well as two of the other thirteen originally-identified sites. The Fire Protection Training Area No. 2 was included in this investigation.

During the Phase II investigation, one shallow monitoring well (I-13) approximately 18 ft deep was installed southeast of the suspected contamination area at Site FT-5/OU-1 in November 1984. Groundwater samples were collected from monitoring well I-13 and fire fighting Supply Well 248 located just northeast of Building 248 within the Ordnance Storage Area. The groundwater samples were analyzed for oil and grease, total organic halogens (TOX), and TOC. The upgradient well, the fire fighting supply well, contained concentrations of TOX just above the detection limit. Monitoring well I-13, installed downgradient of the suspected location on this site, contained the highest TOX value reported during the Phase II investigation. The specific compound(s) responsible for this TOX value were not known but are probably related to chlorinated solvents contained in wastes once used for training fire fighters or related to chlorinated pesticides used in the area

(SAIC, 1986). No significant levels of TOC and biological oxygen demand (BOD) were detected in the wells (SAIC, 1986). The exact location of the actual fire protection training pit was not determined because it has been obscured by the rubble fill northwest of monitoring well I-13.

The Phase II report contained the following alternatives for additional investigation at this site: (1) resample monitoring well I-13 and analyze for halogenated organics to identify the specific compounds involved in the contamination; (2) install a minimum of four additional monitoring wells and collect groundwater samples for analysis of halogenated Priority Pollutants to identify the compounds responsible for the elevated TOX value and to further define the contaminated area; (3) collect surface water and associated sediment samples from a minimum of four locations along the canal which runs east of the site and analyze samples for halogenated Priority Pollutants to define the role of groundwater as a contaminant pathway; and (4) use a combination of alternatives 2 and 3 above which would identify specific contaminants, better define the plume, and characterize the surface water pathway.
The recommendations of the Phase II report however, included additional installation of three monitoring wells and sampling of the new and existing monitoring wells for TOX and organic priority pollutants.

2.3.3 IRP Phase III - Technology Base Development

The IRP Phase III is a research phase and involves technology development for an assessment of environmental impacts. There have been no Phase III tasks conducted at the Base to date.

2.3.4 IRP Phase IV - Additional Investigations

The IRP Phase IV investigations consists of two areas of work activity. Phase IV-A involves additional site investigations necessary to meet the Phase II objectives, a review of all management methods and technologies that could possibly remedy site problems, and preparation of a baseline risk assessment to address the potential hazards to human health and the environment associated with the constituents detected at the site. Detailed alternatives are developed and evaluated and a preferred alternative is selected. The preferred alternative then is described in sufficient detail to serve as a baseline document for initiation of Phase IV-B.

An IRP Phase IV-A investigation was performed at Site FT-5/OU-1 by G&M during two separate field programs, the first in 1988 and the second in 1989. The results of this investigation are included in the report entitled "Draft Remedial Investigation/Endangerment Assessment for Fire Protection Training Area No. 2 (FPTA-2), Homestead Air Force Base, Florida," December 1990.

2.3.4.1 Phase IV-A Soil and Soil Vapor Investigation. In February 1988, during the first field program, a soil vapor investigation was conducted at Site FT-5/OU-1. Twenty-one soil borings (B-43 through B-63) were augured to a depth of approximately 8 ft below land surface (bls) at Site FT-5/OU-1 in the area located adjacent to the elevated fill. After completion, each borehole was sealed for approximately 12 hours prior to analyzing the boring headspace with a PhotovacTM TIP containing a photoionization detector (PID) and calibrated to a 100 parts per million (ppm) isobutylene standard. Organic vapor concentrations greater than ambient levels were detected in six oil borings. Five of the six borings were located just east of the elevated fill area. On the basis of the soil vapor survey, five additional soil borings were drilled to approximately 18 ft bls to install monitoring wells HS-10 through HS-14. Continuous split-spoon formation sample were collected to the total depth of each borehole to determine the physical and lithologic characteristics of the soil/weathered limestone bedrock.

In March and April 1989, during the second field program, 20 additional soil borings were drilled (TW-21 through TW-23, TW-31 through TW-34, FPTA2-SB1 through FPTA2-SB8, FPTA2-MW1(SS1) through FPTA2-MW4(SS4), and FPTA2-DMW1) for a soil and soil vapor investigation. Boreholes TW-21 through TW-23 and TW-31 through TW-34 were drilled to install temporary monitoring wells. Boreholes TW-21 through TW-3, TW-31 and TW-32 were drilled to eight ft bls. Boreholes TW-33 and TW-34 were drilled in the elevated fill area to approximately seven ft bls. Soil samples were collected in each borehole at two-foot intervals until the water table was encountered. The samples were analyzed with an organic vapor analyzer (OVA), containing a flame ionization detector (FID), and a TIP.

Eight exploratory soil borings (FPTA2-SB1 through FPTA2-SB8) were drilled to aid in evaluating the aerial extent of subsurface hydrocarbon constituents. Soil borings FPTA2-SB1 through FPTA2-SB4 were drilled to four ft bls, soil borings FPTA2-SB5 through FPTA2-SB7 to eleven ft bls, and soil boring FPTA2-SB8 to eight ft bls. Split-spoon soil samples were collected in each borehole and analyzed with an OVA and TIP. Additional samples were collected from varying depths in the eight soil borings and submitted to Versar

Laboratory, Inc., for analysis of volatile organic compounds (VOCs), base/neutral acid extractable organic compounds (BNAs), C8-C20 hydrocarbons, and total lead (Table 2-1).

Five additional soil boring locations (FPTA2-MW1[SS1] through FPTA2-MW[SS4] and FPTA2-DMW1) were selected based on the results of the organic vapor analyses and analyses of groundwater collected from temporary monitoring wells. These soil borings were drilled to install five permanent monitoring wells. Split-spoon soil samples were collected in boreholes FPTA2-MW1 through FPTA2-MW4 for chemical analyses by the contracted laboratory. These soil samples were collected above the water table to determine the presence or absence of subsurface hydrocarbon constituents in the vadose zone. Each soil sample was analyzed for the following: VOCs, BNAs, C8-C20 hydrocarbons, and total lead. The results of these analyses are provided in Table 2-2. Split-spoon soil samples also were collected from each monitoring well borehole for on-site organic vapor analysis with an OVA and TIP.

The soil organic vapor analyses indicated elevated organic vapor concentrations using a TIP which is a PID and an OVA which is a FID. The highest organic vapor concentrations were detected in soil collected from depths greater than four ft bls at FPTA2-SB7, FPTA2-SB5, TW-34, and TW-33 which are located in the central area of the elevated fill (G&M, 1990). The maximum detected soil vapor concentrations for soils shallower than four ft bls were detected at FFTA2-MW1, TW-22, and FPTA2-DMW1 which are located immediately east of the elevated fill.

In the eight surface samples collected from 0 to 3 ft bls, BNAs most of which were polynuclear aromatic hydrocarbons (PAHs), were detected in five of the samples, C8-C20 hydrocarbons were detected in one sample, and lead was detected in six of the samples. VOCs were not detected in the surface soil samples collected. In the 11 subsurface soil samples collected from 3 to 10 feet bls, BNAs, most of which were PAHs, were detected in ten of the samples, ethylbenzene and xylenes were detected in one sample, C8-C20 hydrocarbons were detected in two of the samples, and lead in nine of the samples. The highest concentrations of total BNAs were detected in surface sample s collected from 0 to 3 feet his and subsurface samples collected from 3 to 8 feet in the elevated fill area.

2.3.4.2 Phase IV-A Sediment Investigation. In 1988, five sediment samples were collected from the drainage canal adjacent to Site FT-5/OU-1 and were analyzed for VOCs, BNAs, total recoverable petroleum hydrocarbon (TRPH), total lead, and BOD. The results

TABLE 2-1

ANALYTICAL RESULTS OF PHASE IV-A SOIL SAMPLES COLLECTED IN 1989

FROM SOIL BORINGS AT SITE FT-5, FIRE PROTECTION TRAINING AREA NO. 2

Homestead ARB, Florida

LOCATION		FPTA2-SB1	FPTA2-SB2	FPTA2-SB3	FPTA-SB4	FPTA2-SB5		FPTA2-SB6		FPTA2-SB7		FPTA2-SB8	
SAMPLE DEPTH		0 - 2 ft	0 - 3 ft	0 - 2 ft	0 - 2 ft								
						S c/	D d/	S	D	S	D	S	D
CONSTITUENTS a/	UNITS												
VOLATILE ORGANICS	ug/kg	< 29	< 27	< 30	< 32	43	< 31	< 27	< 34	< 28	< 32	< 32	< 32
Ethylbenzene		< 29	< 27	< 30	< 32	84	< 31	< 27	< 34	< 28	< 32	< 32	< 32
Xylene (total)													
BASE/NEUTRAL EXTRACTIBLES	ug/kg												
Acenaphthene		< 633	< 2870	< 694	< 694	6250	< 658	12500	< 676	6400	< 641	11500	821
Anthracene		< 633	[2390]	< 694	< 694	10500	< 658	29400	[355]	17300	[537]	19400	1400
Benzo(a)anthracene		< 633	11100	< 694	< 694	16200	< 658	54400	736	47800	653	37200	2410
Benzo(a)pyrene		< 633	12800	< 694	< 694	8290	< 658	34200	[546]	40000	[590]	23300	1770
Benzo(b)fluoranthene		< 633	17700	< 694	< 694	8560	< 658	41500	[349]	47300	[532]	23100	1940
Benzo(g,h,i)fluoranthene		< 633	14000	< 694	< 694	6520	< 658	33900	< 676	23800	< 641	14400	< 641
Benzo(k)fluoranthene		< 633	18200	< 694	< 694	11200	< 658	45500	< 676	30300	< 641	22500	

2410

Chrysene		< 633	17600	< 694	< 694	14800	< 658	53500	774	46200	785	34900	3300
Di-n-butylphthalate		< 1660 b/	< 2870	< 694	< 694	< 3430	< 658	< 8070	< 676	< 2910	< 641	< 6940	[628] b/
Dibenzo(a,h)anthracene		< 633	4480	< 694	< 694	3800	< 658	13900	< 676	6630	< 641	7250	< 641
2,6-Dinitrotoluene		< 633	< 2870	< 694	< 694	< 3430	< 658	< 8070	< 676	< 2910	< 641	< 6940	653
bis(2-Ethythexyl)phthalate		< 633	< 2870	< 694	< 694	< 3430	< 658	< 8070	< 676	< 2910	< 641	< 6940	[385]
Fluoranthene		< 633	21100	< 694	< 694	31600	< 658	113000	1200	75000	1320	91500	5420
Fluorene		< 633	< 2870	< 694	< 694	6990	< 658	10600	< 676	7090	< 641	11800	738
Indeno(1,2,3-cd)pyrene		< 633	8790	< 694	< 694	4640	< 658	23500	< 676	18500	< 641	< 6940	1390
Naphthalene		< 633	< 2870	< 694	< 694	7400	< 658	9340	< 676	3870	[328]	8390	[337]
Phenanthrene		< 633	9600	< 694	< 694	53600	< 658	152000	1240	74400	1720	144000	6620
Pyrene		< 633	18600	< 694	< 694	24000	< 658	94500	954	56900	1060	62400	6590
C8-C20 HYDROCARBONS (total)	ug/kg	< 12500	< 56900	< 13800	< 12900	114000	< 13000	< 160000	< 13400	< 57600	23600	< 137000	< 12700
TOTAL LEAD e/	mg/kg	< 0.610	78	< 0.63	23	15	< .600	44	2.2	5.6	< 0.61	14	.700

a/ Constituents not detected in any samples are not shown.
b/ Constituent detected in lab blank.
c/ S = shallow sample collected in the 4-8 ft bls range.
d/ D = deeper sample collected in the 6-10 ft bls range.
[] Value is between instrument detection limit and level of quantitation.
e/ Data originally reported in ug/kg.
Source: Geraghty & Miller, Inc. (G&M Project No. TF702.02)

TABLE 2-2
ANALYTICAL RESULTS OF PHASE IV-A SOILS SAMPLES COLLECTED IN 1989
FROM MONITORING WELL BOREHOLES AT SITE FT-5, FIRE PROTECTION TRAINING AREA NO. 2
Homestead ARB, Florida

LOCATION		FPTA2-SS1	FPTA2-SS2		FPTA2-SS3		FPTA2-SS4	
		FPTA2-MW1	FPTA2-MW2		FPTA2-MW3		FPTA2-MW4	
		S	S c/	D d/	S	D	S	D
CONSTITUENTS a/	UNITS							
VOLATILE ORGANICS	ug/kg							
Ethylbenzene		< 7720	< 26	< 29	< 26	< 26	< 28	< 29
Xylene (total)		< 7720	< 26	< 29	< 26	< 26	< 28	< 29
BASE/NEUTRAL EXTRACTABLE ORGANICS	ug/kg							
Acenaphthene		< 15600	20200	15700	[4320]	< 14400	34600	21900
Anthracene		< 15600	56000	25700	14600	15300	52000	44100
Benzo(a)anthracene		[11500]	150000	44900	54600	35600	89900	77600
Benzo(a)pyrene		[11100]	84200	21000	29900	24400	53700	59800
Benzo(b)fluoranthene		< 15600	104000	22800	36500	30800	< 14000	75600
Benzo(g,h,i)perylene		< 15600	56000	24600	25000	28200	37600	71500
Benzo(k)fluoranthene		< 15600	90000	22600	35300	22300	< 14000	70400
Butylbenzlyphthalate		< 15600	< 13600	< 14000	< 5050	< 14400	[11700] b/	67600 b/
Chrysene		16900	129000	41900	53900	37100	97200	82900
Di-n-butylphthalate		< 15600	< 13600	< 14000	< 5050	< 14400	[8030] b/	< 14700
Dibenz(a,h)anthracene		< 15600	19000	< 14000	6600	< 14400	< 14000	< 14700
bis(2-Ethylhexyl)phthalate		< 15600	< 13600	< 14000	< 5050	< 14400	17300	[9180] b/

Fluoranthene		22000	288000	73600	133000	63800	156000	155000
Fluorene		< 15600	14600	[7750]	[3490]	< 14400	35200	27500
Indeno(1,2,3-cd)pyrene		< 15600	52500	24300	16500	22400	41600	73300
Naphthalene		35400	[7610]	[10700]	< 5050	< 14400	[13400]	[11400]
Phenanthrene		17300	340000	117000	79900	66400	210000	186000
Pyrene		22000	230000	77500	109000	69500	143000	127000
C8-C20 HYDROCARBONS (total)	ug/kg	2900000	< 270000	< 279000	< 100000	< 285000	< 279000	< 292000
TOTAL LEAD e/	mg/kg	45	32	23	53	25	8.6	34

a/ Constituents not detected in any samples are not shown.
b/ Constituent detected in lab blank.
c/ S = shallow sample collected in the 0-3 ft bls range.
d/ D = deeper sample collected in the 3-6 ft bls range.
[] Value is between instrument detection limit and level of quantitation.
e/ Data originally in ug/kg.
Source: Geraghty & Miller, Inc. (G&M Project No. TF430.01)

1:\TF702\FPTA2\RI\TABLE2-2.XLS

of these analyses are presented in Table 2-3. Lead was detected in all sediment samples collected.

2.3.4.3 Phase IV-A Surface Water Investigation. In 1988, five surface water samples were collected from the same points along the drainage canal adjacent to Site FT-5/OU-1 as the sediment samples and analyzed for VOCs, BNAs, TRPH, total lead, and BOD. Lead was detected in all surface water samples collected and trichlorofluoromethane was detected in one surface water sample. The concentrations of lead and trichlorofluoromethane, however, were between the analytical method detection limit and the practical quantitation limit (PQL). The practical quantitation limit is the lowest concentration of an analyte that can be quantified by the laboratory, and is generally five to ten time greater than the method detection limit which is the lowest concentration of an analyte that can be reliably detected by the analytical method.

2.3.4.4 Phase IV-A Groundwater Investigation. Phase IV-A groundwater investigations were conducted during both the 1988 and 1989 field programs. Grab groundwater samples were collected from three open boreholes during the 1988 field program to evaluate potential placement of permanent monitoring wells. Five permanent monitoring wells (HS-10 through HS-14) were installed in 1988. Seven temporary monitoring wells (TW-21 through TW-23 and TW-31 through TW-33) were installed during the 1989 field program to evaluate potential placement of additional permanent monitoring wells. Five additional monitoring wells (FPTA2-MW1 though FPTA2-MW4 and FPTA2-DMW1) were installed in 1989. One temporary monitoring well (TW-33) was later converted into permanent monitoring well FPTA2-MW5.

During the 1988 Phase IV-A field programs, grab groundwater samples were collected from three soil borings (B-43, B-57, and B-58) and were analyzed by the contracted laboratory for VOCs. Benzene, chlorobenzene, and ethylbenzene were used only to select locations for the first five permanent monitoring wells. The results from these analyses are presented in Table 2-4.

In February 1988, five shallow (approximately 18 ft deep) monitoring wells (HS-10 through HS- 14) were installed based on the results of the soil vapor investigation. In March of 1988, groundwater samples were collected from the six permanent monitoring wells (HS-10 through HS-14, and I-13) located at Site FT-5. These samples were analyzed for VOCs, BNAs, TRPH, BOD, and total lead. Lead was detected in four of the six samples collected.

TABLE 2-3
ANALYTICAL RESULTS OF PHASE IV-A SEDIMENT SAMPLES COLLECTED IN 1988 AT SITE FT-5,
FIRE PROTECTION TRAINING AREA No. 2
Homestead ARB, Florida

LOCATION / CONSTITUENTS	UNITS	SED01	SED02	SED03	SED04	SED05
VOLATILE ORGANICS	ug/kg	ND	ND	ND	ND	ND
BASE/NEUTRAL AND ACID EXTRACTABLE ORGANICS	ug/kg	ND	ND	ND	ND	ND
TOTAL LEAD d/	mg/kg	30	28	44	22	17
BOD b/	ug/kg	ND	ND	ND	ND	ND
TRPH c/	ug/kg	ND	ND	ND	ND	ND

a/ Constituents not detected in any samples are not shown.
b/ Biochemical oxygen demand.

c/ Total recoverable petroleum hydrocarbons.
[] Value is between instrument detection limit and level of quantitation.
ND Not detected. None of the constituents in this group were detected above their respective detection limits.
d/ Data originally reported in ug/kg.

Source: Geraghty & Miller, Inc. (G&M Project No. TF702.02)

1:\PROJ\TF702\FPTA2\RI\TABLE2-3.XLS

TABLE 2-4
ANALYTICAL RESULTS OF PHASE IV-A GRAB GROUND-WATER SAMPLES
COLLECTED IN 1988 FROM OPEN BOREHOLES AT SITE FT-5,
FIRE PROTECTION TRAINING AREA NO. 2
Homestead ARB, Florida

CONSTITUENTS a/	UNITS	B-43	B-57	B-58
VOLATILE ORGANICS	ug/L			
Benzene		< 5	< 5	655
Chlorobenzene		< 5	< 5	335
Ethylbenzene		< 5	< 5	305

a/ Constituents not detected in any samples are not shown.

Source: Geraghty & Miller, Inc. (G&M Project No. TF702.02)

1:\PROJ\TF702\FPTA2\RI\TABLE2-4.XLS

VOCs, BNAs, TRPH, and BOD were not detected in the monitoring wells. The results from these analyses are presented in Table 2-5.

During the March and April 1989 Phase IV-A field program, seven temporary monitoring wells (TW-21 through TW-23, and TW-31 through TW-34), four permanent shallow monitoring wells (FPTA2-MW1 through FPTA2-MW4), and one permanent deep monitoring well (FPTA2-DMW1) were installed at Site FT-5. Each temporary monitoring well (except for TW-33 and TW-34) was installed to approximately 8 ft bls. Temporary monitoring well TW-33, which was later converted to permanent monitoring well FPTA2-MW5, and TW-34 were installed through the hard fill to approximately 13 ft bls. The five shallow wells are approximately 18 ft deep and the deep well is approximately 40 ft deep. The permanent monitoring well locations were based on the results of the soil vapor survey conducted in 1989 and analyses of groundwater samples collected from temporary monitoring wells.

In March and April of 1989, groundwater samples were collected from six temporary monitoring wells (TW-21 through TW-23, and TW-31 through TW-33) and eleven permanent monitoring wells (FPTA2-MW1 through FPTA2-MW4, FPTA2-DMW1, HS-10 through HS-14, and I-13). These samples were analyzed for: VOCs, BNAs, total C8-C20 hydrocarbons (except TW-21 and TW-23), total lead, and dissolved lead. The temperature, pH, and conductivity of each sample was measured at the time of sample collection.

In the 17 permanent and temporary monitoring wells sampled, VOCs including benzene, ethylbenzene, toluene, chlorobenzene, and xylene were detected in six of the wells, BNAs and lead were detected in four wells, and C8-C20 hydrocarbons were detected in two of the wells samples. The concentrations of toluene, xylene and chlorobenzene were between the instrument detection limit and the practical quantitation limit.

2.3.5 1991 Remedial Investigation of Site FT-5/OU-1

In 1991, a remedial investigation (RI) was conducted at Site FT-5/OU-1 by G&M to evaluate the current groundwater and soil quality with respect to the USEPA Target Compound List (TCL) and Target Analyte List (TAL) for VOCs, BNAs, and metals. The 1991 RI included the collection of four surficial soil samples (0 to 1 foot below the original soil horizon) and 12-groundwater samples from the site's existing monitoring wells.

TABLE 2-5
ANALYTICAL RESULTS OF PHASE IV-A GROUND-WATER SAMPLES COLLECTED IN 1988
FROM PERMANENT MONITORING WELLS AT SITE FT-5,
FIRE PROTECTION TRAINING AREA NO. 2
Homestead ARB, Florida

LOCATION / CONSTITUENTS a/	UNITS	HS-10	HS-11	HS-12	HS-13	HS-14	I-13
VOLATILE ORGANICS	ug/L	ND	ND	ND	ND	ND	ND
BASE/NEUTRAL AND ACID EXTRACTABLE ORGANICS	ug/L	ND	ND	ND	ND	ND	ND
TOTAL LEAD	ug/L	[2.3]	[1.8]	[1.2]	< 1.0	[2.7]	< 1.0
BOD b/	mg/L	< 2	< 2	< 2	< 2	< 2	< 2
TRPH	mg/L	< 0.21	< 0.21	< 0.21	< 0.20	< 0.20	< 0.21

a/ Constituents not detected in any samples are not shown.
b/ Biochemical oxygen demand.
c/ Total recoverable petroleum hydrocarbons.
[] Value is between instrument detection limit and level of quantitation.
ND Not detected. None of the constituents in this group were detected above their respective detection limits.

Source: Geraghty & Miller, Inc. (G&M Project No. TF702.02)

1:\PROJ\TF702\FPTA2\RI\TBL2-5.XLS

2.3.6 1993 Remedial Investigation of Site FT-5/OU-1

In 1993, G&M performed additional RI assessment activities to further evaluate the soil and groundwater quality with respect to the USEPA TCL/TAL for VOCs, BNAs, organochlorine (OC) pesticides/PCBs, and metals, utilizing EPA Contract Laboratory Program (CLP) protocols and to fill data gaps from previous field investigations as well as evaluate any impacts as a result of Hurricane Andrews. Eleven surficial soil samples were collected from the site's existing monitoring wells, and five sediment and surface water samples were collected in the drainage ditch which borders the site.

2.4 COMMUNITY PARTICIPATION HISTORY

The Remedial Investigation/Baseline Risk Assessment report and the Proposed Plan (PP) for Homestead ARB Site FT-5/OU-1 were released to the public in April and November of 1994, respectively. These documents were made available to the public in both the administrative record and an information repository maintained at the Miami-Dade Community College Library.

A public comment period was held from November 8, 1994 to December 23, 1994 as part of the community relations plan for Operable Unit No. 1. Additionally a public meeting was held on Tuesday, November 29, 1994 at 7:00 pm at South Dade High School. A public notice was published in the Miami Herald and the South Dade News Leader on Tuesday, November 22, 1994. At this meeting, the USAF, in coordination with USEPA Region IV, FDEP, and Dade County Environmental Resource Management (DERM), were prepared to discuss the RI results, the Baseline Risk Assessment, the Feasibility Study, and the Proposed Alternative of access restriction for groundwater, use restriction for soil, and groundwater monitoring for contaminant migration and attenuation as described in the PP. A response to the comments received during this period is included in the Responsiveness Summary, which is part of this ROD.

After the close of the November-December 1994 public comment period, Alternative 5 was added for consideration, making a total of five remedial alternatives given further consideration subsequent to the Feasibility Study. This additional alternative includes the biotreatment of contaminated groundwater.

Because of the addition of a fifth remedial alternative for consideration, the public comment period was opened for thirty days, beginning March 14, 1995, and ending April 12, 1995, to provide the public with an opportunity to comment on this added alternative prior to issuance of the final Record of Decision. A notice was placed in the South Dade News Leader on Tuesday, March 14, 1995. No comments were received during this additional public comment period.

This record of decision document presents the selected remedial action for OU-1 at Homestead Air Reserve Base, chosen in accordance with CERCLA, as amended by SARA and, to the extent practicable, the NCP. The decision on the selected remedy for this site is base on the administrative record.

2.5 SCOPE AND ROLE OF RESPONSIBLE ACTION

Currently, many areas within the boundaries of Homestead ARB are under investigation as part of the designated NPL status of the Base. Each of the nine CERCLA investigation areas has been designated as an individual Operable Unit (OU).

The U.S. Air Force with concurrence from the state of Florida and the USEPA, has elected to define OU-1 as the Fire Protection Training Area No. 2. The remedial actions planned at each of the OUs at Homestead ARB are, to the extent practicable, independent of each other. This response action addresses the soil and groundwater contamination identified at OU-1. For hypothetical future adult and child residents, both ingestion of contaminated soil and groundwater pose a risk above the target risk range considered protective of human health by USEPA and FDEP. The total site risks for Site FT-5/OU-1 were estimated above the USEPA and FDEP health-based levels of concern for both current and future land use scenarios.

2.6 SUMMARY OF SITE CHARACTERISTICS

Fire protection training activities were conducted at Site FT-5/OU-1 from 1955 to 1972. A variety of materials were burned at the site including JP-4, aviation gas, various contaminated fuels, and waste liquids from base shops. The area was not equipped with a liner or residual fuel collection system. Extinguishing agents included water, carbon dioxide, aqueous film-forming foam, and protein foam. After training activities ceased at the site in

1972, construction debris was disposed of by dumping and spreading it over the site. A mound of debris, approximately 6 feet high, presently covers an area 600 feet by 400 feet in the southern portion of the site.

The following subsections summarize the nature and extent of the contamination identified at Site Ft-5/OU-1 during investigations conducted from 1988 through 1993. The investigations in 1991 and 1993 were conducted in accordance with the approved Facility Remedial Investigation Work Plan (G&M), 1991. It should be noted that soil samples collected at Site FT-5/OU-1 can be divided into three categories: soil/weathered limestone, limestone bedrock, and fill.

2.6.1 Nature and Extent of Contamination

Remedial investigations have been performed at Site FT-5/OU-1 to evaluate the nature and extent of contamination in 1991 and 1993. A detailed evaluation of the nature and extent of contamination is presented in the RI report addendum prepared by G&M in 1994. In general, the results of the sampling and analysis reveal that contamination in surficial soil/weathered rock samples appears to be confined to the area of the fill and the immediate vicinity of monitoring well FPTA2-MW 1. PAH groundwater contaminants appears to be confined to the elevated fill while BTEX contamination appears to be in the vicinity of monitoring well FPTA2-MW1. Low levels of some constituents were observed in sediment and surface water samples, but non at concentrations above regulatory limits or at levels of human health concern.

2.6.2 Previous Field Investigations

Five field investigations have been performed to date at Site FT-5. The earliest investigation was performed in 1984 by SAIC. One groundwater sample was collected and analyzed for oil and grease, TOX, and TOC. The results of that field investigation recommended further investigations. Additional investigations were conducted in 1988, 1989, 1991, and 1993.

Six groundwater samples and five surface water and sediment samples were collected in 1988 and analyzed for VOCs, BNAs, BOD, TRPH, and lead. Nineteen soil and seventeen groundwater samples were collected in 1989 and analyzed for VOC, BNAs, total C8-C20 hydrocarbons and total lead. Four surface soil and 11 groundwater samples were collected in 1991. The surface soil samples were analyzed for VOCs, BNAs, and metals. The groundwater samples were analyzed for VOCs, BNAs, TRPH, and metals. Finally, 11 surface soil, six groundwater, and five sediment and surface water samples were collected in 1993. All the samples were analyzed for VOCs, BNAs, OC pesticides, metals, and cyanide.

In addition, groundwater samples were analyzed for TDS, sediment samples were analyzed for TOC and acid volatile sulfide, and surface water samples were analyzed for hardness.

2.6.2.1. Background Soil and Groundwater. This section discusses the background data that were obtained by G&M during the 1991 field investigation. This section also discusses the general groundwater quality of the Biscayne Aquifer as well as the background water quality beneath Site FT-5/OU-1. Because there are no chemical-specific ARARs for soils, cleanup objectives are generally established by comparing the existing site conditions to an established "background". This is especially important for metals, which can occur naturally in high concentrations and over large areas.

Background levels for Homestead ARB soils at 0 to 2 ft bls, were based on soil samples collected as background at four CERCLA sites and one RCRA site and are summarized in Table 2-6. Also presented in Table 2-6 are the common range of inorganic constituents found in soils in the eastern U.S., and typical values of both organic and inorganic constituents found in soils in the eastern U.S., and typical values of both organic and inorganic constituents found in uncontaminated soils.

Low levels of some pesticides have been found at several Homestead ARB sites. Pesticides are not considered probable contaminants of site-specific activities at the fire training areas.
Past use of the Base as a crop dusting facility may explain the ubiquitous presence of pesticides. Pesticides were analyzed for at OU-1, but were below health-based levels.

The groundwater in the Biscayne Aquifer has been characterized in a number of studies. Analytical results from water samples collected from water supply wells, canal water (Radell and Katz, 1991), the East Everglades (Waller, 1982), and from the Dade County Landfill (McKenzie, 1983) indicate that all waters are calcium bicarbonate in character. The groundwater is typically classified as "hard", but otherwise is of generally acceptable chemical quality. Dissolved iron concentrations are naturally high in the Biscayne Aquifer and commonly exceed the Florida secondary drinking water regulations. General mineral, trace metal, and major water quality indicators are summarized in Table 2-7. Saline groundwater is found in an area paralleling the coast and extends beneath the Base and Site FT-5 (Klein and Waller, 1985).

2.6.2.2 Volatile Organic Compounds. Ethylbenzene and xylenes were detected at low concentrations (less than 0.1 mg/kg) in one 1989 surface soil sample. In 1991, low concentrations of six VOCs were detected in all four surface soil samples collected. The compounds detected were methylene chloride, acetone, 2-butanone, tetrachloroethene, chlorobenzene, and ethylbenzene. All VOC concentrations detected were below 1 mg/kg with the exception of ethylbenzene. Ethylbenzene was detected at 16 mg/kg in

TABLE 2-6

BACKGROUND SOIL CONCENTRATIONS

Compound	Average Carbonate Composition Hem (1989)	Homestead ARB Background Soil(a) 0-2 ft bls	Typical Values for Uncontaminated Soils(b) (mg/kg)	Common Compound Range(c) (mg/kg)	Average(c) (mg/kg)
Volatile Organic Compounds (æg/kg)					
Acetone		119.2			
Chlorobenzene		3.8			
Methylene Chloride		4			
Total PAHs (æg/kg)		738.55	0.01 - 1.3 forest (d) 0.01 - 1.01 rural 0.06 - 5.8 urban 8 - 336 road dust		
Base/Neutral and Acid Extractable Organic Compounds (æg/kg/dw)					
Acenaphthene		ND			
Benzo(a)anthracene		67			
Benzo(a)pyrene		66			
Benzo(b)fluoranthene		69			
Benzo(g,h,i)perylene		44			
Benzo(k)fluoranthene		66			
bis(2-Ethylhexyl)phthalate		100			
Chrysene		79			
Dibenzofuran		ND			
Fluoranthene		52.4			
Fluorene		ND			
2-Methylnaphthalene		84			
Naphthalene		50			
Phenanthrene		50			
Pyrene		49.15			
1,2-Dichlorobenzene		ND			
1,4-Dichlorobenzene		ND			
Total Phthalates (æg/kg)		126			
Metals (mg/kg)					
Aluminum	8,970	2,400	700->10,000	57000	
Antimony	-	<28 - 30	0 - 30	2 - 10(e)	-(e,f)

Arsenic	1.8	1.6	0 - 30	<0.1 - 73	7.4
Barium	30	42.9	0 - 500	10 - 1,500	420
Beryllium	-	<2.8 - 2.9	0 - 5	<1 - 7	0.85
Cadmium	0.048	<2.8 - 3.0	0 - 1	0.01 - 0.1(e)	0.06(e)
Calcium	272,000	345,000	10 - 28,000	630	
Chromium	>0.1	11.5	0 - 100	1 - 1,000	52
Cobalt	0.12	<1.1 - 1.2	7	<0.3 - 70	9.2
Copper	4.4	<2.7 - 3.0	30	<1 - 700	22
Iron	8,190	1,650	10 - 10,000	2,500	
Lead	16	4.05	0 - 500	<10- 300	17
Magnesium	45,300	1,050	0 - 500	5 - 5,000	460
Manganese	842	23	0 - 500	<2 - 7,000	640
Mercury	0.046	0.014	0 - 1	<0.01 - 3.4	0.12
Nickel	13	<4.5 - 4.7	15	<5 - 700	18
Potassium	2,390	<110 - 120	5 - 3,700	-(f)	
Selenium	-	<5.6 - 5.7	0 - 1	<0.01 - 3.9	0.45
Silver	-	<1.1 - 1.2	0.15	0.01 - 5.0(e)	0.05(e)
Sodium	398	555	<500 - 50,000	7,800	
Thallium	-	<1.1 - 5.6	2.2 - 23	8.6	
Vanadium	13	<5.7 - 5.9	0 - 100	<7 - 300	66
Zinc	16	20	60	<5-2,900	52

(a) Source: Based on 5 background samples as reported in Geraghty & Miller, 1992.
(b) Source: Gas Research Institute, 1987.
(c) U.S. Geological Survey Professional Paper 1270, Element Concentration in Soils and Other Surficial Material of the Conterminous United States Page 4, Table 1 (unless indicated otherwise).
(d) Source: Menzie, et al, 1992.
(e) Data for these metals were included in the USGS Paper. Concentrations were obtained from the USEPA Office of Solid Waste and Emergency Response, Hazardous Waste Land Treatment, SW-874, April 1983, Page 273, Table 6.45.
(f) Average not established.

TABLE 2-7

GENERAL WATER QUALITY

HOMESTEAD AIR RESERVE BASE

SITE FT-5

Parameter	Supply Wells[a]		Canal Water[a]		East Study[b]	West Study[b]	Site FT-5[d,f] Background Well	Site FT-5[d,f] Investigation Wells
	Median	Range	Median	Range	Range	Range	H-11	Range
(Concentrations in micrograms per liter)								
Aluminum	-	-	-	-	0[e] - 70	-	1,500	<200 - 6,100
Antimony	-	-	-	-	-	-	<50	<50
Arsenic	-	-	-	-	0 - 2	1 - 7	26	<10 - 12.1
Barium	24	BDL - 300	36	5 - 100	0 - 100	-	110	<10 - 50.8
Beryllium	-	-	-	-	-	-	<0.5	<0.5
Cadmium	-	-	-	-	0 - 3	1 - 9	<5.0	<5.0
Chromium	1.0	BDL - 90	3	1 - 40	10 - 20	10 - 20	<2,000	<50 to <1,000
Cobalt	-	-	-	-	-	-	<10	<10
Copper	0.7	BDL - 31	3	1 - 80	0 - 11	0 - 2	<25	

<25
Lead
3 BDL - 604 7 1
- 72 0 - 21 0 -
10 9.4
<5.0 - 34
Mercury - - -
- 0.5 0.5 - 0.5 0.46
<0.20
Nickel - - -
- - 2 - 22 <400
<40
Selenium - - -
- 0 - <250
<10 to <50
Silver - - -
- 0 - 1 0 - 60 <10
<10
Thallium - - -
- - - <50
<10
Vanadium - - -
- - - 87
<10 - 19
Zinc - - -
- 10 - 40 - 57
<20 - 490

(Concentrations in milligrams per liter)
Calcium 92 27 - 90 84
74 - 100 93 - 130 72 - 84 91 - 6,300
89 - 1,200
Magnesium 3.7 0.9 - 53 8.8
2.9 - 32 10 - 26 2.8 - 4.0 1.7 - 16
1.6 - 4.5
Manganese 0.014 BDL - 0.150 0.006
0.001 - 0.041 10 - 20 0.1 - 0.3 0.16
<0.010 - 0.05
Iron 0.312 BDL - 21 0.10
0.004 - 1.24 0.75 - 5.0 0.4 - 1.6 0.017
<0.05 - 2.6
Potassium 1.8 0.23 - 16 2.5
1.6 - 6.6 6.2 - 16 0.2 - 9.5 1.4 - 2.9
<1.0 - 6.1
Sodium 22 2.8 - 530 44
23 - 120 54 - 220 8.6 - 13 6.3 - 21
8.3 - 32.9
Bicarbonate 272 66 - 610 276
224 - 415 210 - 284 230 - 440 -
-
Chloride
36 5.0 - 980 78
36 - 190 120 - 450 15

				- 20	-			-
Sulfate	17	0.1 - 160	14	4.3 - 5.3	58 - 99	2.1 - 14	-	-
Nitrate	0.13	<0.04 - 32	0.04	0.01 - 0.19	0.00 - 0.05	0.0 - 0.76	-	-
pH	7.13	6.35 - 7.80	7.62	7.27 - 7.85	7.1 - 7.4	6.7 - 8.0	-	-
TDS	350	111 - 2,130	422	323 - 818	629 - 846	236 - 288	-	-
TOC	14	0.8 - 74	21	5.0 - 46	0 - 13	0 - 83	-	-

a - Radell and Katz, 1991
b - Waller, 1982
c - McKenzie
d - Geraghty & Miller, 1993a
e - Compounds not detected in this study were reported as zero
f - Insufficient data for ion balance verification

From: Geraghty & Miller, 1993a

FPTA2-SL-10. Low concentrations of six VOCs were detected in 10 of the 11 surface soil samples collected in 1993 (Table 2-8). The VOC compounds detected are commonly used as solvents or degreasers and may have been disposed of at Site FT-5; however, several oxygenated VOCs are also common laboratory contaminants. Detections of 2-butanone, methylene chloride, and acetone (detected at low levels in 10 of the 11 samples) may be the result of laboratory contamination.

No VOCs were detected in the six groundwater samples collected in 1988. VOCs were detected in four of the 17 groundwater samples collected in 1989 (Figure 2-1). Benzene was detected in three of the samples at concentrations ranging from 8.7 to 212 micrograms per liter (æg/L). VOCs were detected in two of the 11 samples collected in 1991 (Figure 2-1). Benzene was detected in one of the 1991 samples at a concentration of 2.6 æg/L.

VOCs were detected in one of the six groundwater samples collected in 1993 (Figure 2-1, Table 2-9). Benzene was detected in FPTA-MW-1 at a concentration of 2 æg/L and its duplicate sample FPTA-MW9001 at a concentration of 1 æg/L. This is above and at the state maximum contaminant level (MCL) of 1 æg/L. However, this well contained benzene concentrations of 2.6 æg/L in 1991 and 72 æg/L, in 1989. The overall benzene, toluene, ethylbenzene, and xylenes (BTEX) concentration detected in FPTA2-MW1 and FPTA2-MW9001 (2 and 1 æg/L) in 1993 are approximately 5 and 10 times lower than the concentration of BTEX detected in 1991 (10.9 æg/L) and approximately 50 times lower than the concentration of BTEX detected in 1989 (102 æg/L). The decrease in BTEX in the groundwater at Site FT-5/OU-1 suggests that the BTEX is attenuating naturally, possibly from biodegradation (G&M, 1993a).

VOCs were not detected in the 1988 sediment or surface water samples. VOCs were also not detected in the 1993 sediment samples. Low concentrations (<10 æg/L) of four VOCs (bromodichloromethane, 2-butanone, methylene chloride, and 1,1,1-trichloroethane) were detected in the 1993 surface water samples (Table 2-10). All the VOCs detected in the samples were at concentrations between the instrument detection limit and the practical quantitation limit: and 2-butanone and methylene chloride are probably laboratory contaminants.

2.6.2.3 Total Recoverable Petroleum Hydrocarbons/C8-C20. Petroleum hydrocarbons in the C8-C20 range were detected in two of the 1989 surface soil samples at concentrations of 114 mg/kg and 2,900 mg/kg. Soil samples collected during the 1988, 1991, and 1993 investigations were not analyzed for C8-C20 hydrocarbons.

<IMG SRC 0495250D>

TABLE 2-8

SUMMARY OF CONSTITUENTS DIRECTED IN SOIL SAMPLES COLLECTED IN 1993 AT SITE FT-5, FIRE PROTECTION TRAINING AREA NO. 2

HOMESTEAD AIR FORCE BASE, FLORIDA

(Page 1 of 6)

G&M I.D. FPTA2-SL-0013 FPTA2-SL-9013 FPTA2-SL-0014 FPTA2-SL-0015
Average Carbonate
Homestead AFB Savannah I.D. 40688-7 40688-12 40688-8 40688-9
Composition
Background/b Date Sampled 2/4/93 2/4/93 2/4/93 2/4/93
Parameter
Hem (1989) Average Range
% Solids 80 80 88 85

Volatile Organic Compounds (æg/kg dw)
Methylene Chloride 4
4.0<12 (2,100) U < 1,600

(320) J 340 J
Acetone 119.2
8.3-230.0 12,000 J 5,700
2,300 J* 2,900 J
2-Butanone ND
<12-<24 < 6,200 < 1,600
(1,200) J* (1,200) UJ
Bromodichloromethane ND
<6.1-<12 < 6,200 (160) <
1,400 UJ < 1,500 UJ
Benzene ND
<6.1-<12 < 6,200 < 1,600 <
1,400 UJ < 1,500 UJ
Chlorbenzene 3.8
3.8-<12 < 6,200 < 1,600 <
1,400 UJ < 1,500 UJ
Xylenes ND
<6.1-<12 < 6,200 < 1,600 <
1,400 UJ < 1,500 UJ

Base/Neutral and
Acid Extractable Compounds (æg/kg dw)
3-Methylphenol/4-Methylphenol(m-,p-Cresol) NA
NA-NA < 12,000 < 12,000 <
11,000 (25)
Naphuthalene 50
50-<400 16,000 14,000
27,000 670
2-Methylnaphthalene 84
84-<400 28,000 27,000
20,000 630
Acenaphthylene ND
<390-<400 < 12,000 < 12,000 <
11,000 (92)
3-Nitroaniline ND
<2,000-<2,000 < 31,000 UJ < 31,000 <
28,000 < 940
Acenaphthene ND
<390-<400 < 12,000 < 12,000
31,000 1,700
Dibenzofuran ND
<390-<400 < 12,000 < 12,000
32,000 1,600
Fluorene ND
<390-<400 < 12,000 < 12,000
49,000 1,800
Pentachlorophenol ND
<2,000-<2.000 < 31,000 < 31,000 <
28,000 < 940
Phenanthrene 50
50-<400 (4,700) (3,100)
410,000 19,000
Anthracene ND
<390-<400 (1,200) (790)

					140,000	5,900
Carbazole	NA	NA-NA	< 12,000	< 12,000	66,000 J	2,600
Di-n-butylphthalate	ND	<390-<400	(120)	< 12,000	< 11,000	< 390
Fluoranthene	52.4	7.8-97	(4,400)	(2,900)	440,000	24,000
Pyrene	49.15	6.3-92	(3,600)	(2,500)	320,000	21,000
Butylbenzlyphthalate	16	16-<390	< 12,000	< 12,000	< 11,000	< 390
Benzo(a)anthracene	67	67-<400	(1,700)	(1,300)	190,000	14,000
Chrysene	79	79-<400	(1,700)	(1,600)	210,000	13,000
Benzo(b)fluoranthene	69	69-<400	(1,400)	(860)	210,000	20,000
Benzo(k)fluoranthene	66	66-<400	(1,200)	(1,200)	80,000	6,500
Benzo(a)pyrene	66	66-<400	(1,400)	(910)	150,000	13,000
Indeno(1,2,3-cd)pyrene	45	45-<400	(680)	(630)	37,000	7,900
Dibenz(a,h)anthracene	17	17-<400	< 12,000	< 12,000	17,000	1,300
Benzo(g,h,i)perylene	44	44-<400	(360)	(640)	41,000	7,200

TABLE 2-8

SUM

MARY OF CONSTITUENTS DIRECTED IN SOIL SAMPLES COLLECTED

IN

1993 AT SITE FT-5, FIRE PROTECTION TRAINING AREA NO. 2

HOMESTEAD AIR FORCE BASE, FLORIDA

(Page 2 of 6)

G&M I.D. FPTA2-SL-0013 FPTA2-SL-9013 FPTA2-SL-0014
FPTA2-SL-0015
Average Carbonate
Homestead AFB Savannah I.D. 40688-7 40688-12
40688-8 40688-9
Composition
Background/b Date Sampled 2/4/93 2/4/93
2/4/93 2/4/93
Parameter Hem (1989) Average
Range % Solids 80 80
88 85
Organochlorine Pesticides/PCBs (æg/kg dw)
Heptachlor Epoxide ND ND
<4.7-<5.8 < 11 21
200 J < 100
4,4'-DDE ND ND
<4.7-<5.8 24 (34) <
370 < 190
4,4'-DDD ND ND
<4.7-<5.8 270 340

Metals (mg/kg dw)
Aluminum 8,970 2,400
2,100-2,700 836 433
1,140 1,570
Arsenic 1.8 1.6
<1.1-1.6 < 2.5 UJ < 2.5 <
2.3 UJ 3.3
Barium 30.0 42.9
5.8-(80) < 2.5 < 5.0
(4.1) 6.0 J
Calcium 272,000 345,000
320,000-370,000 333,000 318,000
260,000 296,000
Chromium 7.1 11.5
11-12 6.7 4.5
7.5 9.5
Copper 4.4 ND
<2.7-<3.0 < 6.3 < 6.2 <
5.7 < 5.9
Iron 8,190 1,650
1,500-1,800 555 342
1,330 1,210
Lead 16.0 4.1
1.9-6.2 22.8 20.0
36.4 20.3
Magnesium 45,300 1,050
1,000-1,100 (940) (933)
(860) (982)
Manganese 842.0 23.0
21-25 11.5 10.1
17.2 27.4

Silver	0.19	ND	< 2.5	< 2.5	< 2.3	< 2.3
		<1.1.-<1.2				
Sodium	393	555	(773)	(790)	(472)	(538)
		530-580				
Vanadium	13	ND	(2.6)	< 2.5	(4.5)	(4.9)
		<5.7-<5.9				
Zinc	16	20	6.2	< 5	8.2	19.3
		<12-20				
Cyanide (mg/kg dw)	ND	NA	< 1.3	< 1.3	< 1.1	< 1.2
		NA				

TABLE 2-8

SUMMARY OF CONSTITUENTS DIRECTED IN SOIL SAMPLES COLLECTED IN 1993 AT SITE FT-5, FIRE PROTECTION TRAINING AREA NO. 2

HOMESTEAD AIR FORCE BASE, FLORIDA

(Page 3 of 6)

G&M I.D.			FPTA2-SL-0016	FPTA2-SL-0017	FPTA2-SL-0018	FPTA2-SL-0019
	Average Carbonate Composition					
Homestead AFB Background/b		Savannah I.D.	40688-10	40688-11	40688-13	40688-14
Hem (1989)		Date Sampled	2/4/93	2/4/93	2/4/93	2/4/93
Parameter	Average	Range				
% Solids			89	88	83	83
Volatile Organic Compounds (æg/kg dw)						
Methylene Chloride	4	4.0-<12	< (250) J	< 11	(430) U	(380) U
Acetone	119.2	8.3-230.0	< 1,400	200 J	6,400	3,500
2-Butanone	ND	<12-<24	< 1,400	< 11	<	

1,500 < 1,500
Bromodichloromethane ND
<6.1-<12 < 1,400 < 11 <
1,500 < 1,500
Benzene ND
<6.1-<12 (210) J < 11 <
1,500 < 1,500
Chlorbenzene 3.8
3.8-<12 < 1,400 (4) U <
1,500 < 1,500
Xylenes ND
<6.1-<12 7,000 J < 11 <
1,500 < 1,500

Base/Neutral and
Acid Extractable Compounds (æg/kg dw)
3-Methylphenol/4-Methylphenol(m-,p-Cresol) NA
NA-NA < 11,000 < 370 < 400
< 400
Naphuthalene 50
50-<400 64,000 (37)
(78) < 400
2-Methylnaphthalene 84
84-<400 30,000 (35)
(37) < 400
Acenaphthylene ND
<390-<400 (1,100) (36)
(13) < 400
3-Nitroaniline ND
<2,000-<2,000 < 28,000 < 910 <
960 < 960
Acenaphthene ND
<390-<400 32,000 (60)
(100) < 400
Dibenzofuran ND
<390-<400 36,000 (53)
(70) < 400
Fluorene ND
<390-<400 42,000 (73)
(77) < 400
Pentachlorophenol ND
<2,000-<2,000 (21,000) < 910 <
960 < 960
Phenanthrene 50
50-<400 310,000 990
1,100 (30)
Anthracene ND
<390-<400 85,000 (250)
(130) (6)
Carbazole NA
NA-NA 43,000 (200)
(250) < 400
Di-n-butylphthalate ND
<390-<400 < 11,000 < 370 <

400 < 400
Fluoranthene 52.4
7.8-97 280,000 1,500
1,800 (59)
Pyrene 49.15
6.3-92 200,000 2,600
1,600 (44)
Butylbenzlyphthalate 16
16-<390 < 11,000 (45)
(44) (8)
Benzo(a)anthracene 67
67-<400 110,000 1,300
1,100 < 400
Chrysene 79
79-<400 100,000 930
1,300 < 400
Benzo(b)fluoranthene 69
69-<400 85,000 2,300
1,700 < 400
Benzo(k)fluoranthene 66
66-<400 24,000 (230)
530 < 400
Benzo(a)pyrene 66
66-<400 55,000 1,000
1,100 < 400
Indeno(1,2,3-cd)pyrene 45
45-<400 35,000 1,200
770 < 400
Dibenz(a,h)anthracene 17
17-<400 8,500 (260)
(210) < 400
Benzo(g,h,i)perylene 44
44-<400 29,000 1,200
740 < 400

TABLE 2-8

SUM

MARY OF CONSTITUENTS DIRECTED IN SOIL SAMPLES COLLECTED

IN

1993 AT SITE FT-5, FIRE PROTECTION TRAINING AREA NO. 2

HOMESTEAD AIR FORCE BASE, FLORIDA

(Page 4 of 6)

G&M I.D. FPTA2-SL-0016 FPTA2-SL-0017 FPTA2-SL-0018
FPTA2-SL-0019

Average Carbonate

Homestead AFB Savannah I.D. 40688-10 40688-11

40688-13 40688-14
Composition
Background/b Date Sampled 2/4/93 2/4/93
2/4/93 2/4/93
Parameter Hem (1989) Average
Range % Solids 89 88
83 83
Organochlorine Pesticides/PCBs (æg/kg dw)
Heptachlor Epoxide ND ND
<4.7-<5.8 260 J < 1.9 <
2 < 2
4,4'-DDE ND ND
<4.7-<5.8 < 370 < 3.7 <
4 < 4
4,4'-DDD ND ND
<4.7-<5.8 < 370 < 3.7 <
4 < 4

Metals (mg/kg dw)
Aluminum 8,970 2,400
2,100-2,700 1,440 1,140
1,600 2,680
Arsenic 1.8 1.6
<1.1-1.6 2.3 2.3 <
2.4 UJ 4.5
Barium 30.0 42.9
5.8-80 < 2.2 (13.0) < 2.4
< 2.4
Calcium 272,000 345,000
320,000-370,000 260,000 342,000
284,000 297,000
Chromium 7.1 11.5
1-12 12.1 7.2 8.8
11.5
Copper 4.4 ND
<2.7-<3.0 6.6 15.6 <
6.0 < 6.0
Iron 8,190 1,650
1,500-1,800 766 2,990
1,320 2,220
Lead 16.0 4.1
1.9-6.2 110 33.2
12.1 23.6
Magnesium 45,300 1,050
1,000-1,100 (913) (980)
(987) (907)
Manganese 842.0 23.0
21-25 20.3 24.4
34.2 46.1
Silver 0.19 ND
<1.1-<1.2 < 2.2 < 2.3 <
2.4 < 2.4
Sodium 393 555
530-580 (331) (651)

(493) (602)
Vanadium 13 ND
<5.7-<5.9 (8.5) (3.4)
(4.2) (5.3)
Zinc 16 20
<12-20 11.6 24.4
98.1 22.9

Cyanide (mg/kg dw) ND NA
NA < 1.1 < 1.1 < 1.2
< 1.2

TABLE 2-8

SUM

MARY OF CONSTITUENTS DIRECTED IN SOIL SAMPLES COLLECTED

IN

1993 AT SITE FT-5, FIRE PROTECTION TRAINING AREA NO. 2

HOMESTEAD AIR FORCE BASE, FLORIDA

(Page 5 of 6)

G&M I.D. FPTA2-SL-0020 FPTA2-SL-0021 FPTA2-SL-0022
FPTA2-SL-0023
Average Carbonate
Homestead AFB Savannah I.D. 40688-15 40688-16
40688-17 40688-18
Composition
Background/b Date Sampled 2/4/93 2/4/93
2/4/93 2/4/93
Parameter
Hem (1989) Average Range
% Solids 85 87
83 89

Volatile Organic Compounds (æg/kg dw)
Methylene Chloride 4
4.0-<12 (390) U < 11
(430) U (180)
Acetone 119.2
8.3-230.0 2,200 190 J
3,800 2,900
2-Butanone ND
<12-<24 < 1,500 < 11 <
1,500 < 1,400
Bromodichloromethane ND
<61.-<12 < 1,500 < 11 <
1,500 < 1,400
Benzene ND

<6.1-<12 < 1,500 < 11 <
1,500 < 1,400
Chlorbenzene 3.8
3.8-<12 < 1,500 < 11 <
1,500 < 1,400
Xylenes ND
<6.1-<12 < 1,500 < 11 <
1,500 < 1,400

Base/Neutral and
Acid Extractable Compounds (æg/kg dw)
3-Methylphenol/4-Methylphenol(m-,p-Cresol) NA
NA-NA < 390 < 380 R < 400
< 11,000
Naphuthalene 50
50-<400 (11) < 380 < 400
(670)
2-Methylnaphthalene 84
84-<400 390 < 380 < 400
(530)
Acenaphthylene ND
<390-<400 < 390 < (6) J <
400 (3,000)
3-Nitroaniline ND
<2,000-<2,000 < 940 < 920 <
960 < 28,000
Acenaphthene ND
<390-<400 (96) < 380 <
400 (8,700)
Dibenzofuran ND
<390-<400 (64) < 380 <
400 (9,400)
Fluorene ND
<390-<400 (83) < 380
(43) (10,000)
Pentachlorophenol ND
<2,000-<2,000 < 940 < 920 R <
960 16,000 J
Phenanthrene 50
50-<400 1,300 (120) 1,200
260,000
Anthracene ND
<390-<400 (330) (18)
430 77,000
Carbazole NA
NA-NA (380) J (33) (210)
58,000
Di-n-butylphthalate ND
<390-<400 < 390 < 380 <
400 < 11,000
Fluoranthene 52.4
7.8-97 1,600 410 3,000
360,000
Pyrene 49.15

6.3-92 1,200 (310) 2,700
250,000
Butylbenzlyphthalate 16
16-<390 < 390 9 U < 400
< 11,000
Benzo(a)anthracene 67
67-<400 750 (96) J
2,000 160,000
Chrysene 79
19-<400 650 (260)
1,900 160,000
Benzo(b)fluoranthene 69
69-<400 560 (330)
2,000 140,000
Benzo(k)fluoranthene 66
66-<400 450 (130) 670
28,000
Benzo(a)pyrene 66
66-<400 440 (190)
1,400 100,000
Indeno(1,2,3-cd)pyrene 45
45-<400 (260) (140) 760
64,000
Dibenz(a,h)anthracene 17
17-<400 (63) (38)
(220) 13,000
Benzo(g,h,i)perylene 44
44-<400 (270) (130) 620
37,000

TABLE 2-8

SUM

MARY OF CONSTITUENTS DIRECTED IN SOIL SAMPLES COLLECTED

IN

1993 AT SITE FT-5, FIRE PROTECTION TRAINING AREA NO. 2

HOMESTEAD AIR FORCE BASE, FLORIDA

(Page 6 of 6)

G&M I.D. FPTA2-SL-0020 FPTA2-SL-0021 FPTA2-SL-0022
FPTA2-SL-0023
Average Carbonate
Homestead AFB Savannah I.D. 40688-15 40688-12
40688-17 40688-18
Composition
Background/b Date Sampled 2/4/93 2/4/93
2/4/93 2/4/93
Parameter Hem (1989) Average

```
Range                % Solids                 85                     87
83                         89
        Organochlorine Pesticides/PCBs (æg/kg dw)
           Heptachlor Epoxide                                  ND                  ND
<4.7-<5.8                              <       2            <       2                  <
2                   <        96
           4,4'-DDE                                            ND                  ND
<4.7-<5.8                              <      3.9           <      3.8                 <
4                   <       190
           4,4'-DDD                                            ND                  ND
<4.7-<5.8                              <      3.9           <      3.8                 <
4                   <       190

        Metals (mg/kg dw)
           Aluminum                                          8,970               2,400
2,100-2,700                                   580                  2,540
2,100                      1,260
           Arsenic                                            1.8                 1.6
<1.1-1.6                               <      2.3                  2.5                 <
2.4                  <       2.2         UJ
           Barium                                            30.0                42.9
5.8-80                               <      2.3                 (4.2)                <
2.4                       (2.8)
           Calcium                                          272,000            345,000
320,000-370,000                               339,000               305,000
329,000                    272,000
           Chromium                                           7.1                11.5
11-12                                      73.3                 8.7
10.1                        7.0
           Copper                                             4.4                 ND
<2.7-<3.0                              <      5.9           <      5.7                 <
6.0                  <       5.6
           Iron                                              8,190               1,650
1,500-1,800                                   532                  1,420
1,640                       860
           Lead                                              16.0                 4.1
1.9-6.2                                    94.1                  7.9
7.4                        16.6
           Magnesium                                        45,300               1,050
1,000-1,100                                  (793)               (1,070)
(864)                       978     J
           Manganese                                         842.0               23.0
21-25                                      9.6                  16.9
80.4                       26.5
           Silver                                             0.19                ND
<1.1-<1.2                              <      2.3           <      2.3                 <
2.4                 <       2.2
           Sodium                                             393                 555
530-580                                    (760)                (407)
(359)                      (392)
           Vanadium                                            13                 ND
<5.7-<5.9                                   (2.4)                 (5)
(4.6)                      (3.7)
           Zinc                                                16                 20
```

12-20 12.6 11.5
6.4 8

Cyanide (mg/kg dw) ND NA
NA < 1.2 < 1.1 < 1.2
< 1.1

Notes:

æg/kg micrograms per kilogram
mg/kg milligrams per kilogram
< Analyte was not detected at or above the indicated concentration.
J Positive result has been classified as qualitative due to deficiencies in one or more quality control measures.
() Result is greater than instrument detection limit but less than practical quantitation limit.
UJ Analyte was not detected or has been classified as undetected, with further classification as qualitative.
U Classified as undetected.
R Classified as unusable due to deficiencies in quality control measures.
Result from reanalysis of this sample
[] Concentration exceeded Homestead AFB average background concentration.

TABLE 2-9

SUMMARY OF CONSTITUENTS DETECTED IN GROUNDWATER

SAMPLES COLLECTED IN 1993 AT

SITE FT-5, FIRE PROTECTION TRAINING AREA NO. 2

Homestead Air Reserve Base, Florida

(Page 1 of 3)

Parameter	Florida Ground-water Guidance Concentrations	FAC 17-770 Florida	EPA Drinking Water Standards	EPA Maximum Contaminant Level Goal				
G&M I.D.					HS-11	FPTA2-MW-1	FPTA2-MW-9001	FPTA2-MW2
Savannah I.D.					40763-1	40806-2	40-806-4	40763-2
Date Sampled					2/9/93	2/10/93	2/10/93	2/10/93

m

VOLATILE ORGANIC COMPOUNDS (æg/L):
Benzene 1k 1b
5e NS < 10 (2) J
(1) J < 10

Chlorbenzene 10 NS
NS NS < 10 (4) J
(3) J < 10

Methylene Chloride 5 NS
NS NS (1) U < 10
< 10 U < 10

J

SEMIVOLATILE ORGANIC COMPOUNDS (æg/L):
2-Methylnaphthalene NS d
NS NS < 10 < (0.7)
(1) < 10

3-Methylphenol/4-Methylphenol(m-,p-Cresol) NS NS
NS NS < 10 < 10
(1) < 10

Acenaphthene 20 c
NS NS < 10 < 10
< 10 < 10

Acenaphthylene 10 c
NS NS < 10 < 10
< 10 < 10

Anthracene 10 c
NS NS < 10 < 10
< 10 < 10

bis(2-Ethylhexyl)phthalate 14 NS
4l 0l < 10 (0.9) U
(1) U (0.9) U

Butylbenzlyphthalate 1400 NS
100f 100f < 10 (0.2) U
(0.4) U < 10

Carbazole NS NS
NS NS < 10 < 10
< 10 < 10

Di-n-butylphthalate 700 NS
NS NS < 10 (0.2) U
(0.2) U < 10

Di-n-butylphthalate 10 NS
NS NS < 10 (0.5)
(0.3) < 10

Dibenzofuran NS NS
NS NS < 10 < 10
< 10 < 10

Diethylphthalate 5600 NS
NS NS < 10 (0.2)
< 10 < 10

Fluorene 10 c
NS NS < 10 < 10
< 10 < 10

Fluoranthene 42 c
NS NS < 10 < 10
(0.07) (0.3)

Naphthalene 10 d
NS NS < 10 (0.6)
(1) < 10

Phenanthrene 10 c
NS NS < 10 < 10
(0.2) < 10

Pyrene 10 c
NS NS < 10 (0.03)
(0.05) (0.2)

ORGANOCHLORINE PESTICIDES/PCBs (æg/L):
ND ND ND ND

METALS (æg/L):
Arsenic 50k NS
50g NS < 10 U < 10 U
< 10 U < 10 U

J J J J
Barium
1000k NS 2000i,g
2000i < 10
< 10 < 10
(12.5)

Calcium NS NS
NS NS 91600 89600
92500 115000
Iron 300l NS
300h NS < 50 < 50
< 50 350

Magnesium	NS	NS	NS	NS	(1670)	(1900)	(1920)	(2720)
Manganese	50l	NS	50h	NS	< 10	< 10	< 10	39.2
Potassium	NS	NS	NS	NS	(1350)	(2350)	(2420)	(1760)
Sodium	160000k	NS	NS	NS	6340	9820	10100	8340
Cyanide	154	NS	200f	200f	< 10	< 10	< 10	< 10
TOTAL DISSOLVED SOLIDS (mg/L):	500l	NS	500h	NS	270	290	280	200

TABLE 2-9

SUMMARY OF CONSTITUENTS DETECTED IN GROUNDWATER

SAMPLES COLLECTED IN 1993 AT

SITE FT-5, FIRE PROTECTION TRAINING AREA NO. 2

Homestead Air Reserve Base, Florida

(Page 2 of 3)

Parameter	Florida Ground-water Guidance Concentrations m	FAC 17-770 Florida	EPA Drinking Water Standards	EPA Maximum Contaminant Level Goal	G&M I.D. Savannah I.D. Date Sampled	FPTA2-MW-4 40806-1 2/10/93	FPTA2-MW5 40763-3 2/9/93	FPTA2-DMW1 40806-3 2/10/93	Equipment Blank 40806-8 2/10/93

VOLATILE ORGANIC COMPOUNDS (æg/L):
Benzene 1k 1b
5e NS < 10 < 10 U
< 10 U < 10

J J

Chlorobenzene 10 NS
NS NS < 10 < 10 U
< 10 U < 10

J J

Methylene Chloride 5 NS
NS NS < 10 (1) U
< 10 < 10

SEMIVOLATILE ORGANIC COMPOUNDS (æg/L):
2-Methylnaphthalene NS d
NS NS < 10 < 11 U
< 10 < 10

J

3-Methylphenol/4-Methylphenol(m-,p-Cresol)
NS NS NS
NS < 10
< 11 U < 10 <
10

J

Acenaphthene 20 c
NS NS (2) (4) J
< 10 < 10

Acenaphthylene 10 c
NS NS (0.1) (0.1) J
< 10 < 10

Anthracene 10 c
NS NS (0.4) (2) J
< 10 < 10

bis(2-Ethylhexyl)phthalate 14 NS
4l 0l (0.6) U 60 J

(0.3) U (2) J

Butylbenzlphthalate 1400 NS
100f 100f (0.3) U < 11 U
(0.2) U (0.2) J

J

Carbazole NS NS
NS NS < 10 < 11 U
< 10 < 10

J

Di-n-butylphthalate 700 NS
NS NS < 10 < 11 U
(0.1) U (0.2) J

J

Di-n-octylphthalate 10 NS
NS NS < 10 < 11 U
< 10 < 10

J

Dibenzofuran NS NS
NS NS (1) (4) J
< 10 < 10

Diethylphthalate 5600 NS
NS NS < 10 < 11 U
(0.1) < 10

J

Fluoranthene 42 c
NS NS (3) (5) J
< 10 < 10

Fluorene 10 c
NS NS (0.7) (4) J
< 10 < 10

Naphthalene 10 d
NS NS (0.3) (0.4) J

< 10 < 10

Phenanthrene 10 c
NS NS (0.2) (8) J
< 10 < 10

Pyrene 10 c
NS NS (2) (3) J
< 10 < 10

ORGANOCHLORINE PESTICIDES/PCBs (æg/L):
ND ND ND ND

METALS (æg/L):
Arsenic 50k NS
50g NS < 10 U 12.1
< 10 < 10 U

J J
Barium 1000k NS
2000i,g 2000i (50.8) (47.6)
(13.4) < 10

Calcium NS NS
NS NS 149000 142000
105000 (588)
Iron 300l NS
300h NS 2600 402
< 50 < 50

TABLE 2-9

SUMMARY OF CONSTITUENTS DETECTED IN GROUNDWATER

SAMPLES COLLECTED IN 1993 AT

SITE FT-5, FIRE PROTECTION TRAINING AREA NO. 2

Homestead Air Reserve Base, Florida

(Page 3 of 3)

Parameter Florida FAC
EPA EPA G&M I.D. FPTA2- FPTA2-MW5
FPTA2- Equipment

Savannah I.D. / Date Sampled	Drinking Water Standards	Maximum Contaminant Level Goal	Ground-water Guidance Concentrations m	17-770 Florida	MW-4 40806-1 2/10/93	40763-3 2/9/93	DMW1 40806-3 2/10/93	Blank 40806-8 2/10/93
Magnesium	NS	NS	NS	NS	(4510)	(3340)	(4550)	< 500
Manganese	50h	NS	50l	NS	53.2	(14.4)	< 10	< 10
Potassium	NS	NS	NS	NS	(4250)	(1870)	6170	< 1000
Sodium	NS	NS	160000k	NS	10700	10200	32900	< 500
CYANIDE (æg/L):	200f	200f	154	NS	< 10	< 10	< 10	< 10
TOTAL DISSOLVED SOLIDS (mg/L):	500h	NS	500l	NS	510	470	410	5

NOTES:

b The total of volatile organic aromatics (benzene, toluene, ethylbenzene and xylenes) must be ,50 ug/L to meet FAC 17-770 guidelines.

c The total of polynuclear aromatic hydrocarbons excluding naphthalenes must be <10 ug/L to meet FAC 17-770 guidelines.

d The total of naphthalenes and methyl naphthalenes must be <100 ug/L to meet FAC 17-700 guidelines.

e Numbers represent EPA's Final MCL (Max Contaminant Levels).

f Numbers represent EPA's Proposed Primary MCL or Proposal MCLG, Federal Register, Vol. 55, No. 143, July 1990.

g Numbers represent EPA's Primary MCL for Inorganics.

h Numbers represent EPA's Secondary MCL for Inorganics which are non-enforceable taste, odor or appearance guidelines.

i Numbers represent EPA's Final MCL effective July 1992, Federal Register, January 30, 1991, and July 1, 1991.

k Florida Primary Drinking Water Standard.

l Florida Secondary Drinking Water Standard.

m Florida Ground-Water Guidance Concentrations for Minimum Criteria Requirements (Rule 17-3,402, FAC).
NS No Standard Available.
() Result is greater than instrument detection limit but less than practical quantitation limit.
J Positive result has been classified as qualitative.
UJ Analyte was not detected and has been classified as qualitative.
U Result has been classified as undetected.
* Analytical/Result was generated from a reextraction and reanalysis of the sample.
[] Concentration exceeded Florida Groundwater Guidance Concentration.

TABLE 2-10

SUMMARY OF CONSTITUENTS DETECTED IN SURFACE WATER SAMPLES
COLLECTED IN 1993 AT SITE FT-5
FIRE PROTECTION TRAINING AREA NO. 2
HOMESTEAD AIR RESERVE BASE, FLORIDA

Parameter	Florida Class III Fresh Surface Water Quality Standard	Federal Water Quality Criterion	G&M I.D.	FPTA2-SW-0001	FPTASW2-SW-0002	FPTA2-SW-0003	FPTA2-SW-9003	FPTA2-SW-0004	FPTA2-SW-0005
			Savannah I.D.	40742-6	40742-5	40742-4	40742-3	40742-2	40742-1
			Date Sampled	2/8/93	2/8/93	2/8/93	2/8/93	2/8/93	2/8/93
Volatile Organic Compounds (æg/L)									
Bromodichloromethane	NS	NS		(1)	(1)	(1)	(1)	(2)	(2)
2-Butanone	NS	NS		< 10	< 10	< 10	< 10	< 10	(7)
Methylene Chloride	NS	NS		< 10	< 10	< 10	< 10	(1) U	(8) U
1,1,1-Trichloroethane	NS	NS		< 10	< 10	(2)	(2)	(3)	(4)
Base/Neutral and Acid Extractable Compounds (æg/L)									
bis(2-	NS	NS		< 10	(2) U	18 U	(2) U	(0.4) U	(0.9) U

Ethylhexyl)phthalate								
Butylbenzylphthalate	NS	NS	< 10	(0.2) U	(0.2) U	(0.2) U	(0.2) U	(0.3) U
Organochlorine Pesticides/PCBs (æg/L)			ND	ND	ND	ND	ND	ND
Metals (æg/L)								
Calcium	NS	NS	77,700	77,500	75,800	71,600	74,500	75,800
Magnesium	NS	NS	(2,200)	(2,230)	(2,250)	(2,170)	(2,250)	(2,310)
Potassium	NS	NS	(3,830)	(3,930)	(3,840)	(3,800)	(3,870)	(3,910)
Sodium	NS	NS	13,700	14,000	13,900	14,200	14,400	
Cyanide (æg/L)	<5	5.2	< 10	< 10	< 10	< 10	< 10	
Total Dissolved Solids (mg/L)	NS	NS	203	199	188	195	199	

Notes:
U Classified as undetected.
() Value is greater than instrument detection limit but less than practical quantitation limit.
ND None of the compounds in this analyte group were detected.

TRPH was not detected in any of the 1988 groundwater samples. Concentrations of C8-C20 hydrocarbons were detected in three of the 15 samples taken in 1989 and analyzed for this constituent, at concentrations of 318, 1,510, and 32,000 æg/L. TRPH was detected in three of the 11 groundwater samples collected in 1991. The concentrations of the three samples were 1.0, 6.1, and 27 æ/L. These concentrations were much lower than the 1989 C8-C20 concentrations and were detected in approximately the same locations (Figure 2-1).

TRPH was not detected in any of the 1988 sediment or surface water samples. The sediment and surface water samples collected in 1993 were not analyzed for TRPH.

2.6.2.4 Base/Neutral and Acid Extractable Compounds. BNAS (mostly PAHs) were detected in 15 of the 19 soil samples collected in 1989. The concentration of total PAHs ranged from about 5 to 1,400 mg/kg (Figure 2-2). BNAs (mostly PAHs) were detected in all four of the surface soil samples collected in 1991. The concentration of total PAHs ranged from about 0.6 to 180 mg/kg (Figure 2-2). BNAs (mostly PAHs) were detected in all 11 of the surface soil samples collected in 1993. The concentrations of total PAHs ranged from about 0.1 to 2,372 mg/kg (Figure 2-2, Table 2-8). In general, the highest concentrations of PAHs detected during the investigations were found in and below the fill area, and in an asphalt area east of Campbell Drive. The source of PAHs in the fill area is unknown but is likely from asphalt (which contains PAHs) that was placed at the site after the fire training activities ceased. The PAHs in the other surface soils are likely from the burning activities during fire training exercises and/or from the asphalt in the fill area.

BNAs were not detected in any of the 1988 groundwater samples collected. However, these samples were collected along the perimeter of the elevated fill area and could not be used to characterize groundwater quality beneath the fill, BNAs (mostly PAHs) were detected in four of the 17 groundwater samples collected in 1989. Total PAH concentrations (excluding naphthalene) ranged from about 47 to 436 æg/L. Total naphthalene concentrations ranged from 17 to 388 æ/L (Figure 2-3). BNAs (mostly PAHs) were detected in five of the 11 groundwater samples collected in 1991. Total PAH concentrations (excluding naphthalene) ranged from about 7 to 85 æg/L. Total naphthalene were detected in two samples at concentrations of 0.45 and 70 æg/L (Figure 2-3). BNAs (mostly PAHs) were detected in four of the six groundwater samples collected in 1993. Total PAH concentrations (excluding naphthalene) ranged from less than 1 to 26.1 æg/L. Total naphthalene concentrations ranged from 0.3 to 1.3 æg/L (Figure 2-3, Table 2-9).

<IMG SRC 0495250E>

<IMG SRC 0495250F>

The total PAH concentrations (including naphthalene) detected in groundwater samples FPTA2-MW1/FPTA2-SL-9001, FPTA2-MW2, FPTA2-MW4, and FPTA2-MW5 in 1993 were 100/57, 53, 3, and 3 times lower, respectively, than concentrations detected in 1991. Similar results were found in the Phase I investigation where concentrations of total PAHs detected in samples FPTA2-MW2, FPTA2-MW4, and FPTA2-MW5 analyzed in 1991 were from 2 to 7 times lower than total PAH concentrations detected in 1989. The decrease in total PAH concentrations in monitoring wells FPTA2-MW2, FPTA2-MW4, and FPTA2-MW5 between 1989, 1991, and 1993, and FPTA2-MW1 between 1991 and 1993 suggests that the PAHs are attenuating naturally, probably from aerobic biotransformation (G&M, 1993a). However, total PAHs (excluding naphthalene) detected in one 1993 groundwater sample (FPTA2-MW5) still exceeded the state MCL of 10 æg/L with a concentration of 26.1 æg/L. None of the 1993 groundwater samples collected exceeded the state MCL for total naphthalene of 100 æg/L.

BNAs were not detected in the 1988 surface water samples collected. Two BNAs were detected but classified as undetected in the 1993 surface water samples collected (Table 2-10).

BNAs were not detected in the 1988 sediment samples collected. BNAs (mostly PAHs) were detected in all five of the 1993 sediment samples collected Table 2-11). Total PAH concentrations ranged from about 0.05 to about 8.8 mg/kg. Several of the BNAs detected exceeded National Oceanic and Atmospheric Administration (NOAA) Effects Range-Low (ER-L) guidelines.

2.6.2.5 Inorganics. Lead was detected in 10 of the 12 surface soil samples collected in 1989. The lead concentrations ranged from 0.7 to 78 mg/kg. Lead was detected in all four of the surface soil samples collected in 1991 at concentrations of 21 to 1,100 mg/kg. Originally, the 1991 samples were collected as background samples. However, a review of aerial photographs suggests that these samples were collected in the vicinity of a former fire training pit and are not appropriate background samples. Lead was detected in all 11 of the surface soil samples collected in 1993. The lead concentration detected in 1993 ranged from 7.4 to 110 mg/kg (Table 2-8). Detected lead concentrations are summarized in Figure 2-4.

Because the background soil sample collected at Site FT-5/OU-1 may be inappropriate, lead concentrations detected in surface soil/weathered rock samples collected at Site FT-5 were compared to average Homestead ARB concentrations (Table 2-6). Concentrations of lead

<IMG SRC 0495250G>

detected in 25 of the 27 surface soil/weathered rock samples collected in 1989, 1991, and 1993 were above the Homestead ARB lead background range for surface (0 to 2 ft bls) soil/weathered rock.

Additional target analyte list (TAL) metals and general minerals detected in the four shallow soil samples collected in 1991, and 11 surface soil samples collected in 1993 included aluminum, calcium, barium, cadmium, chromium, copper, iron, magnesium, manganese,

nickel, potassium, sodium, vanadium, zinc, mercury, and arsenic. The 1993 results are presented in Table 2-8. These metals are typically present in carbonate rocks and soils.
According to average carbonate composition data presented by Hem (1989), calcium, magnesium, aluminum, iron, manganese, potassium, and sodium are the most common constituents of carbonates. Additionally, barium, chromium, copper, nickel, vanadium, zinc, mercury, and arsenic occur as trace concentrations. Average concentrations of two common carbonate constituents (calcium and sodium) and three trace carbonate constituents (barium, chromium, and zinc) detected in Homestead ARB background, surface (0 to 2 feet bgs) soil/weathered rock samples were above the average carbonate composition concentrations (Hem, 1989).

Soil samples collected in 1993 were analyzed for cyanide. Cyanide was not detected in any of the 11 soil samples collected.

Lead was detected in four of the six groundwater samples collected in 1988. The concentrations ranged from 1.2 to 2.7 æg/L. Lead was detected in four of the 17 groundwater samples collected in 1989. The concentrations ranged from 7.5 to 311 æg/L. Two of the samples were above the federal action level of 15 æg/L and one the samples was above the state MCL of 50 æg/L. Lead was detected in six of the 11 groundwater wells sampled in 1991. The concentrations ranged from 7.5 to 67 æg/L. Three of the samples were above the federal MCL of 15 æg/L and two samples were above the state MCL of 50 æg/L. Lead was not detected in any of the six groundwater samples collected and analyzed for lead in 1993.
This may be attributed to sampling techniques.

Additional TAL metals and general minerals detected in groundwater samples collected in 1993 include barium, calcium, iron, magnesium, manganese, potassium, sodium, and arsenic (Table 2-9). No groundwater quality standards or guidelines exist for calcium, magnesium, and potassium. Calcium (89,600 to 149,000 æg/L), magnesium (1,670 to 4,550 æg/L), and potassium (1,350 to 6,170 æ/L) are within or slightly above the range of dissolved calcium, magnesium, and potassium reported for the Biscayne aquifer Table 2-7). Arsenic was

detected in one groundwater sample at 12.1 æg/L which is well below the state MCL of 50 æg/L. Barium was detected in four samples at concentrations ranging from 12.5 to 50.8 æg/L, which are well below the state MCL of 1,000 æg/L. Sodium was detected in all groundwater samples at concentrations ranging from 6,340 to 32,900 æg/L, which are well below the state MCL of 160,000 æg/L.

High concentrations of TAL metals including aluminum, lead, and manganese detected in the 1991 groundwater samples have been attributed to the presence of suspended sediments in the groundwater samples. Redevelopment of these wells, which removed suspended sediment, prior to collecting groundwater samples in 1993 provided more accurate measurements of dissolved TAL metals. Aluminum concentration detected in the 1991 samples exceeded the federal Secondary MCL (SMCL) (50 to 200 æg/L) for drinking water. The 1993 samples were all below the detection limit of 200 æg/I. Lead concentrations detected in samples FPTA2-MW1 and FPTA2-MW4, which exceeded the federal MCL of 15 æg/L in 1991, were below the detection limit of 3 æg/L in 1993. Manganese concentrations detected in samples FPTA2-MW2 and HS-11, which exceeded the federal SMCL for drinking water and state Secondary Drinking Water Standards in 1991, were below the detection limit of 10 æg/L in 1993.

Groundwater samples collected in 1993 were analyzed for cyanide. Cyanide was not detected in any of the six samples collected. TDS were detected in 1993 groundwater samples at concentrations ranging from 200 to 510 mg/L. Only one sample contained TDS concentrations above the SMCL of 500 mg/L (Table 2-7).

Lead was detected in all five of the 1993 sediment samples at concentrations ranging from 4.4 to 39.5 mg/kg (Table 2-11). Lead was detected in all five of he 1988 surface water samples collected. The concentrations ranged from 2.6 to 7.5 æg/L. Lead was not detected in any of the 1993 surface water samples.

Additional TAL metals and general minerals detected in 1993 sediment samples include aluminum, calcium, chromium, iron, magnesium, manganese, sodium, vanadium, zinc, and arsenic. At several sampling locations, concentrations of metals detected in the drainage ditch were greater than background sediment (FPTA2-SD-0001) concentrations (Table 2-11). Table 2-12 presents the background sediment (FPTA2-SD-0001) concentrations for all detected metals, the range of concentrations detected in the drainage ditch, and the number of samples above background for each constituent. Each metal (except sodium) was detected at concentrations above the two background samples in at least one sediment sample.

TABLE 2-11

SUMMARY OF CONSTITUENTS DETECTED IN SEDIMENT SAMPLES

COLLECTED IN 1993 AT

SITE FT-5, FIRE PROTECTION TRAINING AREA NO. 2

HOMESTEAD AIR FORCE BASE, FLORIDA

(Page 1 of 2)

Parameter	FPTA2-SD-	FPTA2-SD-	NOAA KR-L	NOAA KR-M	Interim SQC	Interim SQC

G&M I.D. FPTA2-SD- FPTA2-SD- FPTA2-SD- FPTA2-SD-
0004 0005
Valued Valuee (æg/kg) at 1.9%
Savannah I.D. 0001 0002 0003 9003
40742-14 40742-15
OC)b OC Date
Sampled 40742-19 40742-18 40742-17 40742-16
2/6/93 2/6/93
(æg/kg)a %
Solids 2/6/93 2/6/93 2/6/93 2/6/93
44 69

39 57 70 69

Volatile Organic Compounds
ND ND ND ND ND
ND
(æg/L):

Base/Neutral and Acid
Extractable
Compounds (æg/Kg dw)
Anthracene 85 960 NS NS
< 850 < 580 (65) (45) <
720 < 480

Benzo(a)anthracene 230 1.60 1,317,000 25,023
< 850 (60) 700 (430)
(130) (54)
0
Benzo(a)pyrene 400 2.50 1,063,000 20,197
< 850 (69) 850 (460)
(200) (47)
0
Benzo(b)fluoranthene N N NS NS
< 850 (120) 950 610
(280) (52)

Benzo(g,h,i)perylene N N NS NS
< 850 (56) 810 (300)
(150) (28)

Benzo(k)fluoranthene N N NS NS
< 850 (45) 800 510
(200) (42)

Carbazole N N NS NS
< 850 < 580 (68) (74) <
720 < 480

Chrysene 400 2.80 NS NS
< 850 (91) 790 570 J
(270) J (65) J
0

Dibenz(a,h)anthracene 60 260 NS NS
< 850 < 580 < 470 (140)
(71) < 480

Fluoranthene 600 3.60 1,883,000 35,777
(49) (160) 1,300 110 (290)
(110)
0
Indeno(123-cd)pyrene N N NS NS
< 150 (61) 710 (360)
(170) (26)

Fluoranthene 230 1.40 139,000 2,641
< 850 (47) (280) (190)
(66) (80)
0
Pyrene 350 2.20 1,311,000 24,909
< 850 (120) 1,300 J 830 J
(350) J (110)
0

Organochlorine Pesticides/PCBs
(æg/kg dw)
4,4'-DDD 2 20 NS NS
< 8.5 < 5.8 5.4 (3.1) <
7.2 < 4.8

4,41-DDE 2 15 NS NS
< 8.5 < 5.8 7.9 (3.6)
12 < 4.8

Metals (mg/kg dw)
Aluminum N N NS NS
1,320 J 2,850 J 853 J 1,120 J 1,930
J 959 J

Arsenic 33 85 NS NS
< 5.2 U 11.7 J 4.2 J 3.9 J
6.3 J < 2.9 J

J
Calcium N N NS NS
309,000 307,000 313,000 289,000
245,000 263,000
Chromium 80 145 NS NS
8.7 17.3 8.5 8.7 12.6
4.7
Iron N N NS NS
1,200 2,360 808 950 2,120
662

TABLE 2-11

SUMMARY OF CONSTITUENTS DETECTED IN SEDIMENT SAMPLES

COLLECTED IN 1993 AT

SITE FT-5, FIRE PROTECTION TRAINING AREA NO. 2

HOMESTEAD AIR FORCE BASE, FLORIDA

(Page 2 of 2)

Parameter	NOAA KR-L Valued	NOAA A KR-M Values ee	Interim SQC (æg/kg) OC)b	Interim SQC at 1.9% OC (æg/kg)a						
G&M I.D.					FPTA2-SD-0001	FPTA2-SD-0002	FPTA2-SD-0003	FPTA2-SD-9003	FPTA2-SD-0004	FPTA2-SD-0005
Savannah I.D.					40742-19	40742-18	40742-17	40742-16	40742-14	40742-15
Date Sampled					2/6/93	2/6/93	2/6/93	2/6/93	2/6/93	2/6/93
% Solids					39	57	70	69	44	69
Lead	35	110	NS	NS	19	22.5	35.4	31.3	39.5	4.4
Magnesium	N	N	NS	NS	(669)	(880)	(781)	(830)	(776)	(613)
Manganese	N	N	NS	NS	12.8	20.3	12.1	13.1	29.6	9.9
Silver	1	2	NS	NS	< 5.2	< 3.5	< 2.9	< 2.9	< 4.4	< 2.9
Sodium	N	N	NS	NS	(672)	(553)	(403)	(487)	(340)	(401)
Vanadium	N	N	NS	NS	(5.8)	(7.8)	(4.0)	(4.4)	(9.9)	(4.4)
Zinc	120	270	NS	NS	25.6	15.3	49.9	39.0	26.6	6.9

Cyanide (mg/kg dw) NS NS NS NS
< 0.65 < 0.44 < 0.36 < 0.36 <
0.55 < 0.36

Total Organic Carbon (mg/kg dw) NS NS NS NS
< 26,000 18,000 15,000 13,000
25,000 12,000

Acid Volatile Sulfide (mg/kg dw) NS NS NS NS
< 26 < 18 16 22
40 23

AVS Extractable Metals
Lead (7421), mg/kg dw NS NS NS NS
< 9.2 U 8.2 J 17.3 J 20.8 J
23.0 J < 4.9 U

J
J

Zinc NS NS NS NS
21.4 J 9.7 J 25.3 J 26.7 J 18.7
J 5.2 J

Notes:

a The sediment quality criteria (SQC) cannot be directly compared with the Site FT-5 drainage ditch data because the SQC are presented as normalized to organic carbon (i.e., presented on a per organic carbon weight basis. To allow a
direct comparison between Site FT-5 sediment data and SQC, the SQC for the average carbon content, 1.9% OC, in the drainage ditch sediments were calculated. The SQC (æg/kg) at 1.9% OC were derived by multiplying the SQC
(æg/kg OC) by the average OC content of 1.9 % (.019 kg of OC/kg of sediment).

b Organic Carbon

c The criteria is that a sediment is not actively toxic when the molar sum of simultaneously extracted cadmium, copper, mercury, nickel, lead, and zinc is less than the molar acid volatile sulfide concentration (DiToto et al., 1992).

d National Oceanic and Atmospheric Administration (NOAA) Technical Memorandum NOS OMA 52. Effects Range - Low values are concentrations equivalent to the lower 10 percentile of available data screened by NOAA and
indicate the low end of the range of concentrations in specific sediments at which adverse biological effects were observed or predicted in sensitive species and/or sensitive life stages.

e Effects Range - Median values are concentrations equivalent to the midpoint of the range of available data screened by NOAA.

J Positive result has been classified as qualitative.
U Classified as undetected.
UJ Analyte was not detected.
NS No Standard

N No value available

() Value is greater than instrument detection limit but less than practical quantitation limit.

_ Value exceeds NOAA ER-L. To-Be-Considered guidelines

æg/kg micrograms per kilogram dry weight

mg/kg milligrams per kilogram dry weight

ND None of the compounds in this analyte group were detected.

TABLE 2-12

COMPARISON OF METALS DETECTED IN SEDIMENT SAMPLES COLLECTED AT SITE FT-5, FIRE PROTECTION TRAINING AREA NO. 2, WITH BACKGROUND CONCENTRATIONS

HOMESTEAD AIR RESERVE BASE, FLORIDA

Analyte	Average Carbonate Composition a/	Background Boundary Canal b/ Sediment BC-SD-0010	Background Site FT-5 Sediment FPTA2-SD-0001	Site FT-5 Sediment Concentration Range (4) c/
Aluminum	8,970	2,700	1,320	853 - 2,850
Calcium	272,000	310,000	309,000	254,000 - 370,000
Chromium	7.1	11	8.7	4.7 - 17.3
Iron	8,190	1,700	1,200	662 - 2,360
Magnesium	45,300	1,000	669	613 - 880
Manganese	842	<29	12.8	9.9 - 29.6
Sodium	393	290	672	340 - 553
Vanadium	13	5.7	5.8	4.0 - 7.8
Zinc	16	2.7	25.6	6.9 - 49.9
Lead	16	11	19	4.4 - 39.5
Arsenic	1.8	2	<5.2	<2.9 - 11.7

a/ Hem, J.D., 1989 Average carbonate composition of precipitates carbonates.

b/ Boundary Canal sediment samples located approximately 500 feet east of Mystic Lake

on the north side of Homestead AFB.
c/ Number of samples considered.

1:\proj\11704\ft-5\TABL4-16.XLS

The following metals and general minerals were detected in surface water samples collected from the Site FT-5/OU-1 drainage ditch: calcium (71,600-77,700 æ/L), magnesium (2,170-2,250 æ/L), potassium (3,800-3,930 æ/L), and sodium 13,700)-(14,400 æg/L) (Table 2-10). These constituents are present in the groundwater of the Biscayne aquifer, the major source of water in the Site FT-5/OU-I drainage ditch (Table 2-7). Concentrations of calcium, magnesium, potassium, and sodium detected in the Site FT-5 drainage ditch were within the ranges detected in the Biscayne aquifer (Table 2-10).

Cyanide was not detected in any of the 1993 sediment or surface water samples collected.

2.6.2.6 Pesticides/PCBs. The 11 soil samples collected in 1993 were analyzed for target compound list (TCL) pesticides/PCBs. Three pesticides, heptachlor epoxide, 4,4'-DDE, and 4,4'-DDD were detected in the soil/weathered rock samples (Table 2. 3). Heptachlor epoxide was detected in soil/weathered rock samples FPTA2-SL-0014 and FPTA2-SL-0016 at concentrations of 200 and 260 æg/kg, respectively. 4,4'-DDE and 4-4'-DDD were detected in FPTA2-SL-0013 at concentrations of 24 and 270 mg/kg, respectively, and in FPTA2-SL-9013 (duplicate of FPTA2-SL-0013) at concentrations of 34 and 340 æg/kg, respectively. The concentration of 4,4'-DDE detected in FPTA2-SL-9013 was between the method detection limit and practical quantitation limit and the concentrations of heptachlor epoxide detected were qualified because of errors in the associated quality control measures. These pesticides were not detected in average Homestead ARB background concentrations for surface (0 to 2 feet bgs) soil/weathered rock.

Organochlorine pesticides were not detected in groundwater samples collected in 1993. Two organochlorine pesticides were detected in the 1993 sediment samples collected. 4,4'-DDD was detected in two samples at concentrations of 5.4 and 3.1 æg/kg and 4,4'-DDE was detected in three samples at concentrations ranging from 3.6 to 12 æg/kg (Table 2-11). Concentrations of 4,4'-DDD and 4,4'-DDE detected in sediment samples exceeded NOAA ER-L guidelines of 2 æ/kg. Organochlorine pesticides/PCBs were not detected in the surface water samples collected in 1993.

2.6.2.7 Total Organic Carbon. The varying toxicity of nonionic organic chemicals in different sediments is related to the TOC content in sediments. This is due to TOC in sediment controlling the extent of adsorption. TOC was analyzed in all 1993 drainage ditch sediment samples. Concentrations detected in all five sediment samples ranged from 12,000 to 26,000 mg/kg (Table 2-11), with an average TOC of 1.9 percent. The average

TOC of 1.9 percent was used to calculate the interim Sediment Quality Criteria (SQC). The SQC cannot be directly compared with the drainage ditch data because the SQC are presented as normalized to organic carbon (i.e., presented on a per organic-carbon-weight basis). To allow a direct comparison between the drainage ditch data and the SQC, the SQC for the average carbon content in drainage ditch sediments (1.9 percent) was calculated, and is presented in Table 2-11.

2.6.3 Summary

The most prevalent constituents detected in the soil/bedrock and groundwater at Site FT-5 are semivolatile organic compounds (SVOCs) (i.e., BNAs). The SVOCs detected in the soil/bedrock and groundwater are primarily 2- to 5-ring PAHs. VOCs were detected at low levels in some of the surface soil samples collected in 1989 and all of the 1991 and 1993 samples. Most of the VOCs detected are suspected as laboratory contaminants. VOCs, primarily benzene and toluene, were detected in four of the 17 groundwater samples collected in 1989, in two of the 11 groundwater samples collected in 1991, and in one of the six groundwater samples (and its associated duplicate) collected in 1993. VOC concentrations in groundwater decreased significantly since 1989 and 1991 suggesting natural attenuation, possibly from biodegradation.

Metals (except for lead) were detected in the soils and groundwater at Site FT-5 at concentrations within typical background levels. Lead concentrations detected in surface soil samples were generally below 100 mg/kg. Only three sample: had lead concentrations greater than 100 mg/kg. Lead was detected in groundwater samples collected in 1989 and 1991 at concentrations greater than the state MCL. Lead was not detected in the groundwater samples collected in 1993. Low concentrations of VOCs, BNAs, and metals were detected in the sediment and surface water samples.

2.7 SUMMARY OF SITE RISKS

In order to evaluate whether existing or future exposure to contaminated media at Site FT-5/OU-1 could pose a risk to human health and the environment; the USAF completed a Baseline Risk Assessment (BRA) in April 1994, with USEPA oversight of the process. The USAF evaluated potential site risk in the absence of any further remediation. This evaluation then served as a baseline for determining whether cleanup of each site media was necessary.
In the BRA, the USAF evaluated site risk for several environmental media. This ROD addresses the risks attributable to chemicals in the groundwater and soil at Site FT-

5/OU-1.

The BRA included the following major components: selection of chemicals of potential concern (COPC), exposure assessment, toxicity assessment, risk characterization, development of remedial goal options, ecological risk and uncertainties.

2.8 SELECTION OF CHEMICALS OF POTENTIAL CONCERN

Chemicals are included in the BRA as COPCs if the results of an initial screening indicate the chemical might pose a current or future risk above levels deemed protective of human health and the environment by the USEPA. COPCs at Site FT-5/OU-1 were based on the twice background criteria for organic chemicals, elimination of lab contaminants and detection frequency for organic chemicals and essential nutrient elimination. COPCs for soil, groundwater, surface water, and sediment in Table 2-13.

2.9 EXPOSURE ASSESSMENT

In the exposure assessment, USAF considered ways in which people could come into contact with contaminated media under both current and future conditions. A critical step in assessing the potential risk to public health is to identify the pathways through which exposure to chemicals could occur. A typical transport pathway consists of four necessary elements: 1) a source and mechanism of chemical release; 2) an environment transport medium; 3) a point of potential contact with the contaminated medium, and 4) exposure route (inhalation of vapors, ingestion of groundwater, etc.). All four of these elements must be present for pathway to be complete.

2.9.1 Exposure of Concentration

The exposure point concentration for each contaminant was derived using the 95 percent upper confidence limit (UCL95) on the arithmetic mean as defined by the following formula:

$$UCL = e^{\bar{y} + \frac{Sy^2}{2} + \frac{Sy \times H}{n - 1}}$$

where: $\bar{y}$ = arithmetic mean of the log-transformed data

S = standard deviation of the log-transformed data

H = statistical parameter

TABLE 2-13

CHEMICALS OF POTENTIAL CONCERN AT
FT-5, FIRE PROTECTION TRAINING AREA NO. 2
HOMESTEAD AIR RESERVE BASE, FLORIDA
(Page 1 of 2)

Constituent	Groundwater	Surface Soil	Total Soil	Surface Water	Sediment
VOCs					
Acetonea		X	X		
Benzene	X		X		
Bromodichloromethane		X	X	X	
2-Butanonea		X	X	X	
Ethylbenzene		X	X		
Methylene chloridea		X	X		
Toluene	X				
1,1,1-Trichloroethane				X	
Xylenes (total)			X		
BNAs					
Acenaphthene	X	X	X		
Acenaphthylene	X	X	X		
Anthracene	X	X	X		X
Benzo(a)anthracene	X	X	X		X
Benzo(b)fluoranthene	X	X	X		X
Benzo(k)fluoranthene	X	X	X		X
Benzo(a)pyrene	X	X	X		X
Benzo(g,h,i)perylene	X	X	X		X
Butylbenzylphthalate		X	X		
Carbazole		X	X		X
Chrysene	X	X	X		X
Dibenzo(a,h)anthracene		X	X		X
Dibenzofuran	X	X	X		
Diethylphthalate	X				
Fluoranthene	X	X	X		X
Fluorene	X	X	X		
n-Hexaneb	X		X		
Indeno(1,2,3-c,d)pyrene	X	X	X		X
2-Methylnaphthalene	X	X	X		

TABLE 2-13

CHEMICALS OF POTENTIAL CONCERN AT
FT-5, FIRE PROTECTION TRAINING AREA NO. 2
HOMESTEAD AIR RESERVE BASE, FLORIDA
(Page 2 of 2)

Constituent	Groundwater	Surface Soil	Total Soil	Surface Water	Sediment
Naphthalene	X	X	X		
Pentachlorophenol		X	X		
Phenanthrene	X	X	X		X
Pyrene	X	X	X		X
Pesticides					
4,4'-DDD		X	X		X
4,4'-DDE		X	X		X
Heptachlor epoxide			X		
Metals					
Aluminum		X	X		
Arsenic		X	X		
Cadmium			X		
Chromium	X	X	X		
Cobalt		X	X		
Copper	X	X	X		
Iron	X	X	X		
Lead	X	X	X	X	X
Manganese		X	X		X
Nickel		X	X		
Vanadium		X	X		
Zinc	X	X	X		
Petroleum Hydrocarbons	X	X	X		

a Strongly suspected laboratory contaminant.
b n-Hexane is used as a surrogate for petroleum hydrocarbons.

Adapted from: Geraghty & Miller, 1994a,b

Often, with limited data sets, the UCL95 is higher than the maximum detected concentration. If so, the maximum concentration detected was used as the exposure point concentration rather than the UCL95.

2.9.2 Land Use

Hypothetical future use of the site for residential purposes is unlikely. However, for the purposes of the BRA, the hypothetical future risks were evaluated for the possibility of future residential development of the site and installation of a potential potable well.

2.9.3 Exposure Scenarios

Potential current risks at the site were evaluated based on a base worker, accessing the site for cutting the grass, who could ingest soil, have skin contact with soil, or inhale dust from soil. Future populations at risk consisted of hypothetical adults and children. Exposure to contaminated groundwater and soil was evaluated for hypothetical adult and children residents. Risks were evaluated based on conservative use of Reasonable Maximum Exposure (RME) assumptions.

The exposure assumptions for each pathway are provided in Tables 2-14 through 2-16. Based on the exposure point concentrations derived from site data for the chemicals shown in Table 2-13 and using the exposure assumptions identified in Tables 2-14 through 2-16; USEPA estimated the chronic daily intake (CDI) associated with each exposure pathway and population combination. The formula used to calculate the CDI for each pathway are also provided in Tables 2-14 through 2-16.

2.9.4 Toxicity Assessment

The toxicity assessment evaluated possible harmful effects of exposure to each COPC. A number of chemicals found at the site, including polycyclic aromatic hydrocarbons (PAHs), arsenic, benzene, cadmium, chromium, and lead have the potential to cause cancer (carcinogenic). Cancer slope factors (CSFs) have been developed by EPA's Carcinogenic Assessment Group for estimating lifetime cancer risks associated with exposure to potentially carcinogenic compounds. These CSFs, which are expressed in units of (mg/kg-day)-1 are multiplied by the estimated CDI of a potential carcinogen to provide an upper-bound estimate of the excess lifetime cancer risk associated with exposure at the intake level. The term "upper bound" reflects the conservative estimate of the risks calculated for the

TABLE 2-14

EQUATIONS AND SAMPLE CALCULATIONS FOR HYPOTHETICAL FUTURE
POTABLE GROUNDWATER EXPOSURE,
SITE FT-5, FIRE PROTECTION TRAINING AREA NO. 2
HOMESTEAD AIR FORCE BASE, FLORIDA
(Page 1 of 2)

Equation Definitions

$$GWExD. = \frac{EPC \times IR \times EF \times ED}{BW \times AP}$$

$$GWExDd = \frac{EPC \times SSA \times PC \times ET \times EF \times ED}{BW \times AP \times UCF}$$

$$GWExDi = \frac{EPC \times VF \times BR}{BW \times AP} \times EF \times ED$$

$$HI = \frac{GWExD.}{RfD.} + \frac{GWExDd}{RfD.}$$

$$ECLR = [(GWExD. \times CSF.) + (GWExDd \times CSF.)] \times TEF$$

where:

AP Averaging period (equal to ED x 365 days/year for non-cancer effects; 25,500 days [365 days/year for 70 years] for carcinogenic effects) (USEPA, 1989a).
BR Breathing rate (15 m3/day) (USEPA, 1991a).
BW Body weight (70 kg for an adult; 15 kg for a child [aged 0 to 6]) (USEPA, 1991a).
CSF Cancer slope factor for oral (CSF.) or dermal (CSF.) intake (kg-day/mg).
ECLR Excess lifetime cancer risk.
EF Exposure frequency (350 days/year) (USEPA, 1991a).
ET Exposure time while bathing/showering (hours) (15 minutes = 0.25 hour) (Foster and Chrostowski, 1987).
ED Exposure duration (30 years for adult resident; 6 years for a child resident [aged 0 to 6]).
EPCgw Exposure point concentration in groundwater (mg/L) (Table 3.1)
GWExD Potable groundwater exposure dose for oral (GWExD.), dermal (GWExDd), or inhalation (GWExDi) intake (mg/kg/day).
HI Hazard index.
IR Ingestion rate of drinking water (2 liters/day for an adult; 1 liter/day for a child [aged 0 to 6]) (USEPA, 1991a; 1989c).
PC Permeability constant (cm/hour) (Table 3.11).
Rfd Reference dose for oral (Rfd.) or dermal (Rfd.) intake (mg/kg/day).
SSA Exposed skin surface area while bathing/showering (18,150 cm2 for an adult; 5,150 cm2 for a child [aged 0 to 6]) (USEPA, 1989d).
TEF Toxicity equivalency factor for carcinogenic polynuclear aromatic hydrocarbons (PAHs) (Table 3.10); not applicable for other carcinogens.
UCF Unit conversion factor (1,000 cm3/L).
VFw Volatilization factor for volatile organic compounds (VOCs) from household tap water (0.5 L/m3) (USEPA, 1991d).

TP0704023\Dec.1034\25-Apr-94

TABLE 2-14

EQUATIONS AND SAMPLE CALCULATIONS FOR HYPOTHETICAL FUTURE POTABLE GROUNDWATER EXPOSURE, Example Calculation: Cancer Effects of Benzo(k)fluoranthene (Adult Resident)

$$GWExD. = \frac{(0.0027\ mg/L)\ (2\ L/day)\ (350\ days/year)\ (30\ years)}{(70\ kg)\ (25{,}550\ days)}$$

$$= 3.17E-05\ mg/kg/day$$

$$GWExDd = \frac{(0.0027\ mg/L)\ (18{,}150\ cm2)\ (4.1\ cm/hour)\ (0.25\ hour)\ (350\ days/year)\ (30\ years)}{(70\ kg)\ (25{,}550\ days)\ (1{,}000\ cm3/L)}$$

$$= 2.95E-04\ mg/kg/day$$

$$ECLR = [3.175E-5\ mg/kg/day)(7.3\ kg\text{-}day/mg)] \times 0.1$$

$$= 2.3E-05$$

CSFa is not available for benzo(k)fluoranthene; therefore, dermal exposure is not included in the ECLR calculation.

Non-Cancer Effects of Toluene (Child Resident)

$$GWExD. = \frac{(0.0077\ mg/L)\ (1\ L/day)\ (350\ days/year)\ (6\ years)}{(15\ kg)\ (2{,}190\ days)}$$

$$= 4.92E-04\ mg/kg/day$$

$$GWExDd = \frac{(0.0077\ mg/L)\ (5{,}150\ cm2)\ (1.0\ cm/hour)\ (0.25\ hour)\ (350\ days/year)\ (6\ years)}{(15\ kg)\ (2{,}190\ days)\ (1{,}000\ cm3/L)}$$

$$= 6.33E-04\ mg/kg/day$$

$$GWExDi = \frac{(0.0077\ mg/L)\ (0.5\ L/m3)\ (15\ m3/day)\ (350\ days/year)\ (6\ years)}{(1.5\ kg)\ (2{,}190\ days)}$$

$$= 3.69E-03\ mg/kg/day$$

$$HI = \frac{4.92E-04\ mg/kg/day}{2E-01\ mg/kg/day} + \frac{6.33E-04\ mg/kg/day}{2E-01\ mg/kg/day} + \frac{3.69E-03\ mg/kg/day}{1E-01\ mg/kg/day}$$

$$= 4.3E-02$$

TABLE 2-15

EQUATIONS AND SAMPLE CALCULATIONS FOR SOIL EXPOSURE
SITE FT-05, FIRE PROTECTION TRAINING AREA NO. 2
HOMESTEAD AIR RESERVE BASE, FLORIDA
(Page 1 of 4)

Equation Definitions:

[mg/kg/day]
$$SExD. = \frac{EPC. \times IR \times EF \times UC1}{BW \times AP}$$

[mg/kg/day]
$$SExDd = \frac{EPCa \times SSA \times SAR \times ABS \times EF \times ED \times UC1}{BW \times AP}$$

[mg/kg/day]
$$SExDi = \frac{EPC. \times BR \times (1/VF + 1/PEF) \times ET \times EF \times ED}{BW \times AP}$$

[m3/kg]
$$VF = Q/C \times \frac{(3.1416 \times a \times T)1/2 \times UC2}{2 \times Dei \times Pa \times Kas}$$

[m3/kg]
$$PEF = Q/C \times \frac{UC3}{0.036 \times (1-G) \times (Um/Ut)3 \times F}$$

[(g/m2/sec)/(kg/m30]
$$Q/C = (exp\{[0.1004 \times In[A]) - 5.3466] + (2.92 \times sY\})^{-1}$$

[unitless]
$$sY = 0.02685 \times \frac{[0.25 + [In(A) - 11.0509]2}{26.3608}$$

[cm2/sec]
$$a = \frac{Dei \times Pa}{Pa + (ps \times (1 - pa)/Kas]}$$

[cm2/sec]
$$Dei = Di \times (Pa\ 3.33/pt2)$$

[unitless]
$$ECLR = [(SExD. \times CSF.) + (SExDd \times CSFa) + (SExDi \times CSFi)] \times TEF$$

[unitless]
$$HI = \frac{SexD.}{RfD.} + \frac{SExDd}{RfD.} + \frac{SExDi}{RfDi}$$

where:

A Contiguous areas of contamination (m2); 11 acres (44,500 m2).
ABS Dermal absorption efficiency, constituent-specific (Tale 3-11).
AP Averaging period (25,550 days [70 years x 365 days/year] for cancer effects; ED x 365 days/year for non-cancer effects) (USEPA, 1989a).

BR Breathing rate (0.83 m3/hour [20m3/day] for residents; 2.5m3/hour day] for the base worker) (USEPA, 1991a).
BW Body weight (70 kg for an adult; 15 kg for a child [aged 0 to 6] [USEPA, 1991a]).
CSF Cancer slope factor for oral (CSF.), dermal (CSF.), or inhalation (CSFi) intake (kg-day/mg) (Table 3.10).
Dei Effective diffusivity (cm2/sec).
Di Diffusivity in air (cm2/sec) (Table 3.7).
ED Exposure duration (years) (25 years for a base worker [USEPA, 1991a]; 30 years for an adult resident [USEPA, 1989a]; 6 years for a child resident [aged 0 to 6]).
EF Exposure frequency (days/year) (350 days/year for residents [USEPA, 1991a]: 12 days/year for a base worker).
ELCR Excess lifetime cancer risk (unitless).
EPC. Constituent exposure point concentration in soil (mg/kg) (Table 3.2 for base worker; Table 3.3 for residents).
ET Exposure time (4 hours/day for base worker; 24 hours/day for residents).
F Function of Ut/Um (0.0126) unitless; F = 0.18 x [8x3 + 12x] x exp(-x2), where x = 0.886 (Ut/Um).
Foc Fraction organic carbon in soil (0.02).
G Fraction of vegetative cover (unitless); conservatively assumed as zero.
H Henry's Law Constant (atm-m3/mol) (Table 3-7).
HI Hazard index (unitless).
IR Incidental ingestion rate for soil (50 mg/day for a base worker; 100 mg/day for an adult resident; 200 mg/day for a child resident [aged 0 to 6]) (USEPA, 1991a).
Kas Soil-air partition coefficient (g soil/cm2 air); calculated as (41 mol/atm/m3) x H / (Koc x Foc).
Koc Organic carbon partition coefficient (cm3/g or mL/g) (Table 3.7).
Pa Air filled soil porosity (0.06) (unitless).
PEF Particulate emission factor (site-specific) (1.83 x 1010 m3/kg).

Pt Total soil porosity (0.43) (unitless).
ps True soil particle density (2.65 g/cm3).
RfD Reference dose for oral (RfD.), dermal (Rfd.), or inhalation (mg/kg/day) (Table 3.9).
SAR Soil adherence rate (1 mg /cm2/day) (USEPA, 1992b).
SExD Soil exposure dose from oral (SExD.), dermal (SExD.), or inhalation (SExDi) exposure (mg/kg/day).
SSA Exposed skin surface area (3.160 cm2 for base worker [USEPA, 1992b]; 4,650 cm2 for an adult resident; 3,220 cm2 for a child resident [aged 0 to 6] (USEPA, 1989c]).
T Exposure interval (sec) (7.9 x 108 sec [25 years] for a base worker; 9.5 x 108 sec [30 years] for residents).
TEF Toxicity equivalency factor for carcinogenic polynuclear aromatic hydrocarbons (PAHs) (Table 3.10); not applicable for other constituents.
UC1 Unit conversion 1 (10-6 kg/mg).
UC2 Unit conversion 2 (10-4 m2-cm2).
UC3 Unit conversion 3 (3,600 sec/hour).
Um Wind speed (4 m/sec [NOAA, 1974]).
Ut Equivalent threshold value of windspeed at 10 meters (12.8 m/sec).
VF Volatilization factor (site-and constituent-specific) (m3/kg).

Sample Calculation: Cancer effects of Chrysene (base worker)

SExD. = (160 mg/kg) x (50 mg/d) x (12 d/yr) x (25 yrs) x (10-6 kg/mg)
(70 kg) x (25,550d)

= 1.34 x 10-6 mg/kg/d

SExD4 = (160mg/kg) x (3,160 cm2) x (1 mg/cm 2/d) x (0.03) x (12 d/yr) x (25 yrs) x (10-4 kg/mg)
(70 kg) x (25,550d)

= 2.54 x 10-6 mg/kg/d

Dei = (0.04531 cm2/sec) x (0.063.33/0.432) = 2.09 x 10-5 cm2/sec

Kas = (41 mol/atm/m3) x (3.15 x 10-7 atm-m3/mol) = 2.69 x 10-6 g/cm3
(240,000 cm3/g) x (0.02)

a = 12.09 x 10-5 cm2/sec x 0.06 = 1.36 x 10-15 cm2/sec
0.06 + [92.65 g/cm3) x (1-0.06)/(2.69 x 10-6 g/cm3)]

sY = 0.02685 x [0.25 + [In(44,500 m2) - 11.0509]2 = 0.006836
26.3608

-1
Q/C = (exp{[0.1004 x In[44,500m2]) - 5.3466] + (2.92 x 0.006836})

= 70.25 (g/m2/sec/(kg/m3)

VF = [70.25 g/m2/sec] x [3.1416 x (1.36 x 10-15 cm2/sec) x (7.9 x 108 sec)]1/2 x (10-4 m2/cm2)
kg/m3 2 x (2.09 x 10-6 cm2/sec) x 0.06 x (2.69 x 10-8 g/cm3)

= 1.91 x 108 m3/kg

PEF = [70.25 g/m2/sec] x 3,600 sec/hour
kg/m3 (0.036 g/m2/hr) x (1 - 0) x ([4 m/sec)/(12.8 m/sec)]3 x 0.01257

= 1.83 x 1010 m3/kg

SExDi = (160 mg/kg) x (2.5 m3/hr) x [(1/1.91 x 106 m3/kg) + (1/1.83 x 1010 m3/kg)] x (4 hr/d) x (12 d/yr) x (25 yrs)
(70 kg) x (25,550 d)

= 1.56 x 10-10 mg/kg/d

ELCR = {[(1.34 x 10-6 mg/kg/d) x (7.3kg -d/mg)] + [(1.56 x 10-10 mg/kg/d) x (6.1kg -d/mg)]} x 0.01

9.8 x 10-8
(CSF, is not available for chrysene; therefore dermal exposure is not included in the ECLR calculation.)

TP070401\Dec.10003\4-06\part.wp\26-Apr-94

TABLE 2-15

EQUATIONS AND SAMPLE CALCULATIONS FOR SOIL EXPOSURE
SITE FT-05, FIRE PROTECTION TRAINING AREA NO. 2
HOMESTEAD AIR RESERVE BASE, FLORIDA
(Page 4 of 4)

Sample Calculation: Non-Cancer Effects of Cobalt (adult resident)

SExD. = (1.3 mg/kg) x (100 mg/d) x (350 d/yr) x (30 yrs) x (10-8 kg/mg)
(70 kg) x (10.950 d)

= 1.78 x 10-8 mg/kg/d

SExDd = (1.3 mg/kg) x (4,650 cm2) x (1 mg/cm2/d) x 0.001 x (350 d/yr) x (30 yrs) x (10-6 kg/mg)
(70 kg) x (10.950d)

= 8.28 x 10-6 mg/kg/d

SExDi = (1.3 mg/kg) x [0 +(1/1.83 x 1010 m3/kg)] x (0.83 m3/hr) x (24 hr/d) x (350 d/yr) x (30 yrs)
(70 kg) x (10,950 d)

= 1.94 x 10-11 mg/kg/d

HI = 1.78 x 10-6 mg/kg/d + 8.28 x 10-6 mg/kg/d
6 x 10-2 mg/kg/d 2 x 10-2 mg/kg/d

= 0.000034

(RfDi is not available for cobalt; therefore, inhalation exposure is not included in the HI calculation.)

TP070401\Dec.10003\4-06\part.wp\26-Apr-94

TABLE 2-16

EQUATIONS AND SAMPLE CALCULATIONS FOR WADING EXPOSURE
SITE FT-5, FIRE PROTECTION TRAINING AREA NO. 2
HOMESTEAD AIR RESERVE BASE, FLORIDA
(Page 1 of 2)

Equation Definitions:

WExD. = EPC... x IR... x ED x EF x ET + EPC... x IRL... x ED x EF
BW x AP
BW x AP x UCi

WExD4 = EPC... x SSA x PC x UC2 x ED x EF x ET + EPC... x SSA x SAR x ABS x ED x EF
BW x AP
BW x AP x UCi

ECLR = [(WExD. x CSF.) + (WExDd x CSF.)] x TEF

HI = (WExD./RfD.) + (WExDd/Rfd.)

where:

ABS	Dermal absorption efficiency, constituent-specific (from Table 3.11).
AP	Averaging period (equal to ED x 365 days/year for non-cancer effects; 25,550 days [70 years x 365 days/year] for cancer effects) (USEPA, 1991a).
BW	Body weight (70 kg for an adult; 38 kg for an older child [aged 6 to 15 years] (USEPA, 1991a;USEPA, 1989c).
CSF.	Cancer slope factor adjusted to an absorbed dose (kg-day/mg) (from Table 3.10).
CSF.	Cancer slop factor for oral exposure (kg-day/mg) (from Table 3.10).
ED	Exposure duration (25 years for a base worker; 9 years for an older child [aged 6 to 15 year]).
EF	Exposure frequency (12 days/year).
ELCR	Excess lifetime cancer risk (unitless).
EPC...	Constituent exposure point concentration in the surface water (mg/L) (Table 3.4).
EPC...	Constituent exposure point concentration in the sediment (mg/kg) (Table 3.4).
ET	Exposure time (8 hours/day for a base worker; 2.6 hours/day for an older child).
HI	Hazard Index (unitless).
IR...	Incidental ingestion rate of sediment while wading (5 mg/day).
IR...	Incidental ingestion rate of surface water while wading (0.005 liters/hour).
PC	Permeability constant (cm/hour) (from Table 3.11).
Rfd.	Reference dose adjusted to an absorbed dose (mg/kg/day) (from Table 3.9).
Rfd.	Reference dose for oral exposure (mg/kg/day) (from Table 3.9).
SAR	Sediment adherence rate (1 mg/cm2/day) (USEPA, 1992b).
SSA	Exposed skin surface area (3,120 cm2 for a base worker; 3,715 cm2 for an older child [aged 6 to 15 years]) (USEPA, 1991a; 1989c).
TEF	Toxicity equivalency factor for carcinogenic polynuclear aromatic hydrocarbons (PAHs); not applicable for other constituents.
UC1	Unit conversion 1 (106 mg/kg).
UC2	Unit conversion 2 (10-3 L/cm3).
WExDd	Wading exposure dose from dermal contact (mg/kg/day).
WExD.	Wading exposure dose from incidental ingestion (mg/kg/day).

TABLE 2-16

EQUATIONS AND SAMPLE CALCULATIONS FOR WADING EXPOSURE
SITE FT-5, FIRE PROTECTION TRAINING AREA NO. 2
HOMESTEAD AIR RESERVE BASE, FLORIDA
(Page 2 of 2)

Sample calculation - Bromodichloromethane, cancer effects, base worker:

WExD. = (0.0020 mg/L) x (0.005 L/hr) x (25 yrs) x (12 days/yr) x (8 hrs/day)
(70 kg) x (25,550 days)

= 1.3 x 10-8 mg/kg/day

WExDd = (0.0020 mg/L) x (3,120 cm2) x (5.8 x 10-3 cm/hr) x (10-3 L/cm3) x (25 yrs) x (12 days/yr) x (8 hrs/day)
(70 kg) x (25,550 days)

= 4.9 x 10-8 mg/kg/day

ELCR = [(1.3 x 10-8 mg/kg/day) x (0.062 kg-day/mg)] + [(4.9 x 10-8 mg/kg/day) x (0.062 kg/day/mg)]

= 3.8 x 10-9

Sample Calculations - phenanthrene, non-cancer effects, child:

WExD. = (0.28 mg/kg) x (5 mg/day) x (9 yrs) x (12 days/yr)
(38 kg) x (3.285 days) x 106 mg/kg)

= 1.2 x 10-9 mg/kg/day

WExDd = (0.28 mg/kg) x (3,715 cm2) x (1mg/cm2/day) x (0.03) x (9 yrs) x (12 days/yr)
(38 kg) x (3,285 days) x (106 mg/kg)

= 2.7 x 10-8 mg/kg/day

HI = 1.2 x 10-8 mg/kg/day + 2.7 x 10-8 mg/kg/day
3 x 10-2 mg/kg/day 3 x 10-2 mg/kg/day

= 9.4 x 10-7

CSF. Use of the approach makes underestimation of the actual cancer risk highly unlikely. Slope factors are derived from results of human epidemiological studies or chronic animal bioassays to which animal to human extrapolation and uncertainty factors have been applied. The CSFs for the carcinogenic contaminants of concern are contained in Table 2-17.

As an interim procedure until more definitive Agency guidance is established. Region IV has adopted a toxicity equivalency factor (TEF) methodology for evaluating the carcinogenic risks from PAHs. This methodology relates the relative potency of each individual carcinogenic PAH to the potency of benzo(a)pyrene, the most carcinogenic PAH. The TEFs for the PAHs are also presented in Table 2-17.

Other COPCs, including other PAHs and metals, may cause health problems other than cancer. Reference doses (RfDs) have been developed by EPA for indicating the potential for adverse health effects from exposure to contaminants of concern exhibiting non-carcinogenic effects. RfDs, which are expressed in units of (mg/kg-day)-1, are estimates of lifetime daily exposure levels for humans, including sensitive individuals, that are believed to be safe by EPA. RfDs are derived from human epidemiological studies or animal studies to which uncertainty factors have been applied (e.g., to account for the use of animal data to predict effects on humans). Estimated intakes of COPCs from contaminated media can be compared to their respective RfDs. The RfDs for the noncarcinogenic contaminants of concern are provided in Table 2-18.

2.9.5 Risk Characterization

The centerpiece of the BRA is the risk characterization, which combines the other components of the evaluation to estimate the overall risk from exposure to site contamination.

In summary, the results of the BRA indicate that human health risks associated with potential current and future land use scenarios at Site FT-5/OU-1 exceed EPA's and FDEPs target risk range for protection of human health.

2.9.5.1 Carcinogenic Risk. For cancer causing compounds, risk is a probability that is expressed in scientific notation. For example, an excess lifetime cancer risk of 1x10-6 means that an individual has an additional 1 in 1,000,000 chance of developing cancer as a result of site-related exposure over an estimated 70 year lifetime. EPA has established a target risk

TABLE 2-17

CANCER SLOPE FACTORS, TUMOR SITES AND USEPA CANCER CLASSIFICATIONS
FOR CONSTITUENTS OF CONCERN,
SITE FT-5, FIRE PROTECTION TRAINING AREA NO. 2
Homestead Air Reserve Base, Florida

Constituent	CSF (mg/kg/day) 1 Oral	Adjusted[a]	Inhalation	TEF	Tumor site Oral	Inhalation	USEPA Classification
VOCs							
Benzene	2.9E-02	2.9E-02	2.9E-02	--	leukemia	leukemia	A
Bromodichloromethane	6.2E-02	6.2E-02	NA	--	liver	NA	B2
Methylene Chloride	7.5E-03	7.5E-03	1.6E-03	--	liver	lung,liver	B2
BNAs							
Benzo(a)anthracene*	5.8E-01	IAP	6.1E-01	0.1	NA	NA	B2
Benzo(b)fluoranthene*	5.8E-01	IAP	6.1E-01	0.1	NA	NA	B2
Benzo(k)fluoranthene*	5.8E-01	IAP	6.1E-01	0.1	NA	NA	B2
Benzo(a)pyrene	5.8E+00	IAP	6.1E+00	1	stomach	respiratory tract	B2
Butylbenzylphthalate	NA	IAP	NA	--	NA	NA	C
Carbazole	2.0E-02	IAP	NA	--	NA	NA	B2
Chrysene*	5.8E-02	IAP	6.1E-02	0.01	NA	NA	B2
Dibenzo(a,h)anthracene*	5.8E+00	IAP	6.1E+00	1	NA	NA	B2
Indeno(1,2,3-c,d)pyrene*	5.8E-01	IAP	6.1E-01	0.1	NA	NA	B2
Pentachlorophenol	1.2E-01	1.3E-01	NA	--	liver, adrenal gland	NA	B2
Pesticides							
4,4'-DDD	2.4E-01	2.7E-01	NA	--	liver	NA	B2
4,4'-DDE	3.4E-01	3.8E-01	NA	--	liver	NA	B2
Heptachlor	9.1E+00	1.5E+01	9.1E+00	--	liver	liver	B2

Inorganics							
Arsenic	1.75E+00	1.8E+00	1.5E+01	--	skin	respiratory tract	A
Cadmium	NAP	NAP	6.1E+00	--	NA	respiratory tract	B1
Chromium VI	NAP	NAP	4.2E+01	--	NA	lung	A
Lead	NA	NA	NA	--	NA	NA	B2
Nickel	NAP	NAP	8.4E-01	--	NA	respiratory tract	A

References: ATSDR, 1991c; IRIS, 1992; USEPA, 1992a,b.

[a] The CSF adjusted to an absorbed dose was used to assess dermal exposure. The adjusted CSF was derived according to USEPA (1989a) methodology by dividing the oral CSF by the constituent-specific oral absorption efficiency (Table 3-8).

* The oral and inhalation CSF was converted to an equivalent concentration on benzo(a)pyrene following the Interim USEPA Region IV guidance on the toxicity equivalency factor (TEF) methodology for carcinogenic PAHs (USEPA, 1992a).

-- Not applicable; the TEF is relevant only for the carcinogenic PAHs.

IAP Inappropriate to adjust the oral CSF for carcinogenic PAHs to evaluate dermal exposure (USEPA, 1989a).

mg/kg/day Milligrams per kilogram per day.

NA Not available.

PAHs Polynuclear aromatic hydrocarbons

TEF Toxicity equivalency factor for carcinogenic PAHs

NAP Not applicable since it is carcinogenic by Inhalation only.

DOC.1003\Table 2-17 REV.JUNE-1-92 KK

TABLE 2-18

REFERENCE DOSES FOR CONSTITUENTS OF CONCERN, SITE FT-5, FIRE PROTECTION TRAINING AREA NO. 2 Homestead Air Reserve Base, Florida

Constituent	Oral Rfd (mg/kg/day)	Adjusted RfDa (mg/kg/day)	Inhalation RfD (mg/kg/day)
VOCs			
Acetone	1.0E-01	1.0E-01	NA
Benzene	NA	NA	1.0E-04
Bromodichloromethane	2.02-02	2.0E-02	

			NA
2-Butanone	6.0E-02	6.0E-02	3.0E-02
Ethylbenzene	1.0E-01	1.0E-01	2.9E-01
Methylene Chloride	6.0E-02	6.0E-02	9.0E-01
Toluene	2.0E-01	2.0E-01	1.0E-01
1,1,1-Trichloroethane	9.0E-02	9.0E-02	3.0E-01
Xylene	2.0E+00	2.0E+00	NA
BNAs			
Acenaphthene	6.0E-02	5.4E-02	NA
Acenaphthylene	3.0E-02	2.7E-02	NA
Anthracene	3.0E-01	2.7E-01	NA
Benzo(g,h,i)perylene	3.0E-02	2.7E-02	NA
Butylbenzylphthalate	2.0E-01	2.0E-01	NA
Carbazole	NA	NA	NA
Dibenzofuran	3.0E-02	2.7E-02	NA
Diethylphthalate	8.0E-01	8.0E-01	NA
Fluoranthene	4.0E-02	3.6E-02	NA
Fluorene	4.0E-02	3.6E-02	NA
n-Hexaneb	6.0E-02	6.0E-02	6.0E-02
2-Methylnaphthalene	4.0E-02	2.7E-02	3.7E-04
Naphthalene	4.0E-03	3.6E-03	3.7E-04
Pentachlorophenol	3.0E-02	3.0E-02	NA
Phenanthrene	3.0E-02	2.7E-02	NA
Pyrene	3.0E-02	2.7E-02	NA
Pesticides			
4,4'-DDD	3.0E-03	3.0E-03	NA
4,4'-DDE	7.0E-04	6.0E-04	

			NA
Heptachlor epoxide	1.3E-05	7.8E-06	NA
Inorganics			
Aluminum	NA	NA	NA
Arsenic	3.0E-04	2.9E-04	NA
Barium	7.0E-02	5.0E-03	1.4E-04
Cadmium (foof)	1.0E-03	2.0E-05	NA
Cadmium (water)	5.0E-04	1.0E-05	NA
Chromium	5.0E-03	1.0E-04	NA
Cobalt	6.0E-02	2.0E-02	NA
Copperc	3.7E-02	2.2E-02	NA
Iron	NA	NA	NA
Lead	NA	NA	NA
Manganese	1.4E-01	7.0E-05	1.1E-04
Mercury	3.0E-04	5.0E-05	9.0E-05
Nickel	2.0E-02	9.0E-03	NA
Vanadium	7.0E-03	7.0E-05	NA
Zinc	3.0E-01	9.0E-02	NA

Notes

a The RfD adjusted to an absorbed dose was used to assess dermal exposure. The adjusted RfD was derived according to USEPA (1989a) methodology by multiplying the oral RfD by the constituent-specific oral absorption efficiency (from Table 3-9).

b n-Hexane is used as a surrogate for C8 to C20 hydrocarbons.

c Based on current drinking-water standard.

NA Not available.

References: ATSDR, 1991d; IRIS, 1992; USEPA, 1992a.

range for DOD and Superfund cleanups of between 1x10-4 (1 in 10,000) and 1x10-6. However, the state of Florida's target risk is 1x10-6.

The formula used for calculating cancer risk is shown below:

$$Risk = CDI \times CSF$$

where: Risk = a unitless probability of an individual developing cancer
CDI = chronic daily intake averaged over 7, years (mg/kg)
CSF = cancer slope factor, expressed as $(mg/kg\text{-}day)^{-1}$

Potential current site risk for a base worker exposed to surficial soils results in a total site excess lifetime cancer risk of 1×10^{-5}.

The excess lifetime cancer risk for a hypothetical future adult and child resident exposed to groundwater are 3×10^{-4} and 2×10^{-4}, respectively. The excess lifetime cancer risks for hypothetical future adult and child residents exposed to soil at the site are 1×10^{-3} and 2×10^{-3}, respectively. The cancer risk for the hypothetical future adult and child resident exceeds the upper end for the risk range deemed protective of human health by USEPA and the FDEP.

Hazards due to non-carcinogenic chemicals: for compounds which cause toxic effects other than cancer, EPA compared the exposure point concentration of a contaminant found at the site with a reference does representing the maximum amount of a chemical a person could be exposed to without experiencing harmful effects. The ratio of the average daily intake to the reference dose is called a hazard quotient (HQ). The formula for calculating the HQ is shown below:

$$\text{Non-cancer HQ} = CDI/RfD$$

where CDI = chronic daily intake
RfD = reference dose

CDI and RfD are expressed in the same units $(mg/kg\text{-}day)^{-1}$ and represent the same exposure period (i.e., generally chronic, but also subchronic, or short-term).

The hazard index (HI) can be generated by adding the HQs for all contaminants of concern that affect the same target organ (such as the liver) within a median or across all media to which a given population may reasonably be exposed. In general, EPA considers an HI of 1.0 to be the maximum acceptable hazard.

The HI for a current base worker exposed to surficial soils is 0.005. The HI for the future adult and child residents exposed to groundwater at Site FT-5/OU-1 are 10 and 40, respectively. The HI for the future adult and child resident exposed to soils are 0.2 and 1, respectively.

The non-cancer HI for hypothetical future adult and child resident exposure to groundwater is above the USEPA risk benchmark of 1. Hypothetical future hazards for residents exposed to soils (both an adult and a young child aged 0 to 6 years) are a or below the USEPA benchmarks (0.2 and 1 for the adult and child, respectively).

2.9.52 Total Risk. The total site risk for the current base worker exposed to surficial soils and to surface water and sediments is 1x10-5 and HI of 0.005. These risk values for potential exposure do not exceed the USEPA risk benchmark of 10-4 for cancer risk and 1 for non-cancer risk; however, they do exceed the FDEP benchmark of 10-6. The risk for hypothetical future adult resident exposure to groundwater and soil is 1 x 10-3 and a total site HI of 10. The cancer risk for soil and groundwater exceed USEPA and FDEP health-based levels. The non-cancer risk also exceeds the USEPA benchmark of 1. Hypothetical future cancer and non-cancer risk were calculated for a young child (age 0 to 6 years) exposed to groundwater and soils and for an older child (aged 6 to 15 years) exposed to surface water and sediments. The calculated cancer and non-cancer risks for the young child and the older child were added to obtain the total site risk for a hypothetical child resident. The total site risk for future child exposure to groundwater, soil, surface water, and sediment is 2 x 10-3 and an HI of 30. Both risks exceed USEPA and FDEP health based levels.

2.9.5.3 Risk from Lead Exposure. Based on the results from the USEPA Lead5 model, the lead concentrations in soil and groundwater at Site FT-5/OU-1 are unlikely to cause adverse effects for young children.

2.9.6 Chemicals of Concern and Remedial Goal Option

COCs contribute significantly to a use scenario for a receptor that (a) exceeds a 10-4 total carcinogenic risk, (b) exceeds an HI of 1, or (c) exceeds a state or federal chemical specific ARAR. Chemicals need not be included if their individual carcinogenic risk contribution is less than 1x10-6 or their non-carcinogenic HQ is less than 1. For this site, the relevant RGOs are for TPH and PAHs.

RGOs are risk-based cleanup levels: they are developed by combining the intake levels to each chemical receptor from all appropriate routes of exposure (i.e., inhalation, ingestion, and dermal) and pathways within a scenario and rearranging the site specific CDI equations used in the risk characterization to solve for the concentration term. RGOs are developed for each medium, each land use, and each receptor type.

The RGOs are presented here in tabular form and include cleanup levels for the 10-4, 10-5, and 10-6 levels for each COC, medium, and scenario and the HQs of 0.1, 1, and 10 levels as well as any chemical-specific ARARs. A summary of the risk-hazard RGOs are presented in Tables 2-19 through 2-21.

2.9.7 Uncertainties in the Risk Assessment

The risk estimates presented in the BRA are conservative estimates of the risks associated with current and hypothetical future exposure to media at the site. Actual risks are almost certainly lower than those presented. Further, there is considerable uncertainty inherent in the risk assessment process. Sources of uncertainty can be summarized as follows:

Environmental sampling may not fully identify constituent distribution.

Exposure doses calculated for hypothetical future scenarios do not take into account natural attenuation processes that will reduce constituent concentrations and the likelihood of exposure.

Toxicity values and other toxicologic information used to calculate risks are associated with significant uncertainty; most information has been developed using laboratory animals exposed to high doses.

Sufficient toxicological data may not be available for all detected constituents. As a result, surrogate compounds were used to evaluate PAHs and petroleum hydrocarbons.

Non-carcinogenic risks associated with potential lead exposure were evaluated differently from other COCs in the risk assessment.

TABLE 2-19

RISK BASED REMEDIAL GOAL OPTIONS FOR SOIL

BASED ON POTENTIAL CURRENT BASE WORKER EXPOSER

SITE FT-5, FIRE PROTECTION TRAINING AREA NO. 2

HOMESTEAD AIR FORCE

BASE, FLORIDA

Constituents	EPCss	Non-Cancer Risk Based RGOs			Cancer Risk Base RGOs		
	THI:	0.1	1	10	0.000001	0.00001	0.0001
VOCs							
Acetone	12	260,000	2,600,000	26,000,000	--	--	--
Bromodichloromethane	0.16	--	--	--	1,200	12,000	120,000
2-Butanone	0.15	790,000	7,900,000	79,000,000	--	--	--
Ethylbenzene	16	230,000	2,300,000	23,000,000	--	--	--
Methylene chloride		--	--	--	7,500	75,000	750,000
SVOCs							
Acenaphthene	35	78,000	780,000	7,800,000	--	--	--
Acenaphthylene	4	44,000	440,000	4,400,000	--	--	--
Anthracene	77	440,000	4,400,000	44,000,000	--	--	--
Benzo(a)anthracene	160	--	--	--	160	1,600	16,000
Benzo(b)fluoranthene	140	--	--	--	160	1,600	16,000
Benzo(k)fluoranthene	90	--	--	--	160	1,600	16,000
Benzo(a)pyrene	100	--	--	--	16	160	1,600
Benzo(g,h,i)perylene	56	44,000	440,000	4,400,000	--	--	--
Butylbenzylphthalate	12	520,000	5,200,000	52,000,000	--	--	--
Carbazole	58	--	--	--	3,700	37,000	370,000
Chrysene	160	--	--	--	1,600	16,000	160,000
Dibenzofuran	13	44,000	440,000	4,400,000	--	--	--
Dibenzo(a,h)anthracene	19	--	--	--	16	160	1,600
Fluoranthene	360	48,000	480,000	4,800,000	--	--	--
Fluorene	35	48,000	480,000	4,800,000	--	--	--

n-Hexanea	2,900	160,000	1,600,000	16,000,000	--	--	--
Indeno(1,2,3-c,d)pyrene	64	--	--	--	160	1,600	16,000
2-Methylnaphthalene	92	29,000	290,000	2,900,000	--	--	--
Naphthalene	49	17,000	170,000	1,700,000	--	--	--
Pentachlorophenol	16	--	--	--	28	280	2,800
Phenanathrene	340	44,000	440,000	4,400,000	--	--	--
Pyrene	250	44,000	440,000	4,400,000	--	--	--

TABLE 2-19

RISK BASED REMEDIAL GOAL OPTIONS FOR SOIL

BASED ON POTENTIAL CURRENT BASE WORKER EXPOSER

SITE FT-5, FIRE PROTECTION TRAINING AREA NO. 2

HOMESTEAD AIR FORCE BASE, FLORIDA

(Page 1 of 2)

Constituents	EPCss	Non-Cancer Risk Based RGOs			Cancer Risk Base RGOs		
	THI:	0.1	1	10	0.000001	0.00001	0.0001
Pesticides							
4,4'-DDD	0.34	--	--	--	150	1,500	15,000
4,4-DDE	0.034	--	--	--	110	1,100	11,000
Inorganics							
Aluminum	7,300	--	--				
Arsenic	8.6	6,400,000	64,000,000	640,000,000	--	--	--
Barium	48	160,000	1,600,000	16,000,000	--	--	--
Cobalt	1.4	210,000	2,100,000	21,000,000	--	--	--
Chromium	36	--	--	--	270,000	2,700,000	27,000,000
Copper	10	120,000	1,200,000				

				12,000,000	--	--	--
Iron	8,400	--	--	--	--	--	--
Lead	980	--	--	--	--	--	--
Manganese	140	250,000	2,500,000	25,000,000	--	--	--
Mercury	0.022	120	1,200	12,000	--	--	--
Nickel	7.8	--	--	--	13,000,000	130,000,000	1,300,000,000
Vanadium	7.8	4,100	41,000	410,000	--	--	--
Zinc	91	1,100,000	11,000,000	110,000,000	--	--	--

Concentrations are given in milligrams per kilogram (mg/kg)
Risk-based RGOs which are less that the current EPCss are indicated with a cell border
-- RGO not available or not applicable
a n-Hexane is a surrogate for petroleum hydrocarbons
EPCss Exposure point concentration in surficial soil (from G&M, 1994b)
RGO Remedial goal option
TCR Target cancer risk
THI Target hazard index
Source: Geraghty and Miller, 1994b

TABLE 2-20

RISK BASED REMEDIAL GOAL OPTIONS FOR SOIL

BASED ON HYPOTHETICAL FUTURE ADULT RESIDENT EXPOSURE

SITE FT-5, FIRE PROTECTION TRAINING AREA NO. 2

HOMESTEAD AIR FORCE BASE, FLORIDA

(Page 1 of 2)

Constituents	EPCss	Non-Cancer Risk Based RGOs			Cancer Risk Base RGOs		
	THI:	0.1	1	10	0.000001	0.00001	0.0001
VOCs							
Acetone	12	5,000	50,000	500,000	--	--	--
Benzene	0.21	--	--	--	24	240	2,400
Bromodichloromethane	0.16	--	--	--			

					19	190	1,900
2-Butanone	0.8	15,000	150,000	1,500,000	--	--	--
Ethylbenzene	3.3	4,300	43,000	430,000	--	--	--
Methylene chloride	0.21	--	--	--	120	1,200	12,000
Xylenes	2.5	100,000	1,000,000	10,000,000	--	--	--
SVOCs							
Acenaphthene	61	1,600	16,000	160,000	--	--	--
Acenaphthylene	4	910	9,100	91,000	--	--	--
Anthracene	190	9,100	91,000	910,000	--	--	--
Benzo(a)anthracene	190	--	--	--	2.3	23	230
Benzo(b)fluoranthene	210	--	--	--	2.3	23	230
Benzo(k)fluoranthene	120	--	--	--	2.3	23	230
Benzo(a)pyrene	150	--	--	--	0.23	2.3	23
Benzo(g,h,i)perylene	72	910	9,100	91,000	--	--	--
Butylbenzylphthalate	52	1,000	10,000	100,000	--	--	--
Carbazole	66	--	--	--	58	580	5,800
Chrysene	210	--	--	--	23	230	2,300
Dibenzofuran	25	910	9,100	91,000	--	--	--
Dibenzo(a,h)anthracene	24	--	--	--	0.23	2.3	23
Fluoranthene	440	1,000	10,000	100,000	--	--	--
Fluorene	82	1,000	10,000	100,000	--	--	--
n-Hexanea	680	3,000	30,000	300,000	--	--	--
Indeno(1,2,3-c,d)pyrene	81	--	--	--	2.3	23	230
2-Methylnaphthalene	34	580	5,800	58,000	--	--	--
Naphthalene	64	330	3,300	33,000	--	--	--
Pentachlorophenol	21	--	--	--	0.54	5.4	54
Phenanathrene	410	910	9,100	91,000	--	--	--

Pyrene	320	910	9,100	91,000	--	--	--

TABLE 2-20
RISK BASED REMEDIAL GOAL OPTIONS FOR SOIL
BASED ON HYPOTHETICAL FUTURE ADULT RESIDENT EXPOSURE
SITE FT-5, FIRE PROTECTION TRAINING AREA NO. 2
HOMESTEAD AIR FORCE BASE, FLORIDA
(Page 2 of 2)

Constituents	EPCss	Non-Cancer Risk Based RGOs			Cancer Risk Base RGOs		
	THI:	0.1	1	10	0.000001	0.00001	0.0001
Pesticides							
4,4'-DDD	0.34	--	--	--	2.6	26	260
4,4-DDE	0.034	--	--	--	1.8	18	180
heptachlor epoxide	0.26	--	--	--	0.022	0.22	2
Inorganics							
Aluminum	4,500	--	--	--	--	--	--
Arsenic	6	--	--	--	0.93	9.3	93
Barium	29	3,100	31,000	310,000	--	--	--
Cadmium	0.86	--	--	--	26,000	260,000	2,600,000
Chromium	24	--	--	--	3,800	38,000	380,000
Cobalt	1.3	3,800	38,000	380,000	--	--	--
Copper	7.6	2,000	20,000	200,000	--	--	--
Iron	4,900	--	--	--	--	--	--
Lead	330	--	--	--	--	--	--

Manganese	81	4,900	49,000	490,000	--	--	--
Mercury	0.021	2.7	27	270	--	--	--
Nickel	6.6	--	--	--	190,000	1,900,000	19,000,000
Vanadium	6.9	90	900	9,000	--	--	--
Zinc	48	19,000	190,000	1,900,000	--	--	--

Concentrations are given in milligrams per kilogram (mg/kg)
Risk-based RGOs which are less that the current EPCss are indicated with a cell border

--	RGO not available or not applicable
a	n-Hexane is a surrogate for petroleum hydrocarbons
EPCss	Exposure point concentration in soil (Table 3.3)
RGO	Remedial goal option
TCR	Target cancer risk
THI	Target hazard index
Source:	Geraghty and Miller, 1994b

TABLE 2-21
RISK BASED REMEDIAL GOAL OPTIONS FOR SOIL
BASED ON HYPOTHETICAL FUTURE CHILD RESIDENT EXPOSURE
SITE FT-5, FIRE PROTECTION TRAINING AREA NO. 2
HOMESTEAD AIR FORCE BASE, FLORIDA
(Page 1 of 2)

Constituents	EPCss	Non-Cancer Risk Based RGOs			Cancer Risk Base RGOs		
	THI:	0.1	1	10	0.000001	0.00001	0.0001
VOCs							
Acetone	12	670	6,700	67,000	--	--	--
Benzene	0.21	--	--	--	19	190	1,900
Bromodichloromethane	0.16	--	--	--	13	130	1,300
2-Butanone	0.8	2,500	25,000	250,000	--	--	--
Ethylbenzene	3.3	610	6,100	61,000	--	--	--

Methylene chloride	0.21	--	--	--	88	880	8,800
Xylenes	2.5	13,000	130,000	1,300,000	--	--	--
SVOCs							
Acenaphthene	61	300	3,000	30,000	--	--	--
Acenaphthylene	4	160	1,600	16,000	--	--	--
Anthracene	190	1,600	16,000	160,000	--	--	--
Benzo(a)anthracene	190	--	--	--	1.2	12	120
Benzo(b)fluoranthene	210	--	--	--	1.2	12	120
Benzo(k)fluoranthene	120	--	--	--	1.2	12	120
Benzo(a)pyrene	150	--	--	--	0.12	1.2	12
Benzo(g,h,i)perylene	72	160	1,600	16,000	--	--	--
Butylbenzylphthalate	52	1,300	13,000	130,000	--	--	--
Carbazole	66	--	--	--	39	390	3,900
Chrysene	210	--	--	--	12	120	1,200
Dibenzofuran	25	160	1,600	16,000	--	--	--
Dibenzo(a,h)anthracene	24	--	--	--	0.12	1.2	12
Fluoranthene	440	190	1,900	19,000	--	--	--
Fluorene	82	190	1,900	19,000	--	--	--
n-Hexanea	680	400	4,000	40,000	--	--	--
Indeno(1,2,3-c,d)pyrene	81	--	--	--	1.2	12	120
2-Methylnaphthalene	34	110	1,100	11,000	--	--	--
Naphthalene	64	67	670	6,700	--	--	--
Pentachlorophenol	21		--	--	0.78	7.8	78
Phenanathrene	410	160	1,600	16,000	--	--	--
Pyrene	320	160	1,600	16,000	--	--	--

TABLE 2-21

RISK BASED REMEDIAL GOAL OPTIONS FOR SOIL

BASED ON HYPOTHETICAL FUTURE CHILD RESIDENT EXPOSURE

SITE FT-5, FIRE PROTECTION TRAINING AREA NO. 2

HOMESTEAD AIR FORCE BASE, FLORIDA

(Page 2 of 2)

Constituents	EPCss	Non-Cancer Risk Based RGOs			Cancer Risk Base RGOs		
	THI:	0.1	1	10	0.000001	0.00001	0.0001
Pesticides							
4,4'-DDD	0.34	--	--	--	2.4	24	240
4,4-DDE	0.034	--	--	--	1.7	17	170
Heptachlor epoxide	0.26	--	--	--	0.027	0.27	3
Inorganics							
Aluminum	4,500	--	--	--	--	--	--
Arsenic	6	--	--	--	0.51	5.1	51
Barium	29	450	4,500	45,000	--	--	--
Cadmium	0.86	--	--	--	27,000	270,000	2,700,000
Chromium	24	--	--	--	4,100	41,000	410,000
Cobalt	1.3	450	4,500	45,000	--	--	--
Copper	7.6	230	2,300	23,000	--	--	--
Iron	4,900	--	--	--	--	--	--
Lead	330	--	--	--	--	--	--
Manganese	81	780	7,800	78,000	--	--	--
Mercury	0.021	0.67	6.7	67	--	--	--
Nickel	6.6	--	--	--	200,000	2,000,000	20,000,000
Vanadium	6.9	21	210	2,100			

						--	--	--
Zinc	48		2,200	22,000	220,000	--	--	--

Concentrations are given in milligrams per kilogram (mg/kg)
Risk-based RGOs which are less that the current EPCss are indicated with a cell border

--	RGO not available or not applicable
a	n-Hexane is a surrogate for petroleum hydrocarbons
EPCss	Exposure point concentration in soil (Table 3.3)
RGO	Remedial goal option
TCR	Target cancer risk
THI	Target hazard index
Source:	Geraghty and Miller, 1994b

There is considerable uncertainty associated with the toxicity of mixtures. The risk assessment assumes that toxicity is additive; the mixture of constituents present has neither synergistic not antagonistic interaction; and that all of the constituents have the same mechanism of action in the same target organ to produce the same toxic endpoints.

The use of conservative assumptions and models and the conversation built into the RfDs and CSFs are believed to result in an overestimate of risk. Therefore, actual risk may be much lower than the estimates presented in the BRA but are unlikely to be greater.

2.9.7.1 Ecological Risks. Conditions at OU-1 provide little usable or preferred habitat for terrestrial species. Limited vegitation is available for food or cover and the shallow depth of soil to bedrock restricts the activities of burrowing animals. While avian species may visit the site, it is unlikely that they would derive a significant portion of their diet from the limited resources available. The potential water hazards to acquatic life from groundwater contaminants being transported and discharged to surface water bodies (i.e., the OU-1 drainage canal or the Boundary Canal) are considered low due to dilution and mixing. The limited distribution of contaminants in the canal sediments also indicated a low potential for ecological effects to acquatic organisms.

Four state threatened plant species (pine ferm, brake fern, southern shield fern, and tetrazygia) were identified along the drainage ditch comprising the south and east boundaries of Site FT-5/OU-1. The occurrence of special status species is concern due to their limited numbers and precarious state of existence. However, in view of the limited extent of soil and sediment contamination at Site FT-5/OU1, it is unlikely that contamination is present in the areas inhabited by these threatened species.

2.10 DESCRIPTION OF ALTERNATIVES

The USAF initially considered seven alternatives in the Feasibility Study (FS) to address the soil and groundwater contamination identified at OU-1. The seven alternatives were screened based on the criteria of effectiveness, implementability, and cost. Four of the most promising alternatives were carried forward through complete evaluation. These four alternatives were then evaluated against the mine CERCLA criteria requirements for selecting a remedial alternative. These nine criteria include effectiveness, implementability, cost, state acceptance, community acceptance, long-term effectiveness and permanence, reduction of mobility, toxicity, or volume through treatment, compliance with ARARs, short term effectiveness, and overall protection of human health and environment. A summary of the four alternatives is presented below while each is described in greater detail in the FS.

It should be noted that estimated costs for some of the alternatives presented herein differ from those presented in the September 1994 Final Feasibility Study Report. These costs differences arise primarily from the reduced cost of disposal to a municipal landfill (where applicable) with respect to the cost of disposal in a RCRA hazardous waste disposal facility.

2.10.1 Alternative 1 - No-Action with Groundwater Monitoring of Contaminants for Migration and Attenuation

The No-Action Alternative is evaluated as required by the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), the regulation implementing CERCLA, for comparison with other alternatives. Semiannual groundwater monitoring would be conducted for two years under the No Action Alternative on six existing monitor wells to monitor migration and attenuation of groundwater contaminants. After the two year monitoring program is completed, review of the site would be performed to evaluate the contaminant migration and attenuation. Per CERCLA, site reviews every 5 years would be conducted as part of this alternative since COCs exceeding USEPA target risk ranges would remain on-site. The groundwater monitoring program may be discontinued after the 5-year site review, if contamination is below health-based levels.

The present-worth cost of this alternative is estimated at $522,000 with capital costs of $27,000 and an annual operation and maintenance (O&M) cost of $29,500.

2.10.2 Alternative 2 - Access Restrictions for Groundwater, Use Restrictions for Soil, and Groundwater Monitoring of Contaminant Migration and Attenuation

This alternative includes access restrictions that would prevent placement of potable wells in the contaminated groundwater beneath OU-1. Groundwater monitoring would be conducted to monitor the migration and natural attenuation of the contaminant plume. Zoning restrictions by deed would also be utilized to prevent schools, playgrounds, hospitals, and residential units from being built at OU-1 to limit exposure to adults and children. This alternative would also prevent the practice of continued disposal of rubble at the site. Groundwater monitoring would be performed semiannually for 2 years followed by review to evaluate contaminant migration and attenuation to below levels of concern. Natural attenuation is expected to degrade the contaminants below levels of health and environmental concerns within 2-5 years. Review of the site would be conducted at least every 5 years to ensure that the remedy continues to provide adequate protection of human health and the environment.

The present-worth cost of this alternative is estimated at $330,000 with capital costs of $55,000 and an annual O&M cost of $58,800. The reduction in estimated costs compared with those reported in the Feasibility Study are attributed to the reduced duration of the groundwater monitoring program.

2.10.3 Alternative 3 - Access Restriction for Groundwater, Use Restriction for Soil, Treatment of Rubble and Topsoil, and Groundwater Monitoring of Contaminant Migration and Attenuation

This alternative would include all the factors previously discussed in Alternative 2 with the addition of treatment and disposal of the rubble pile and topsoil. The rubble pile, along with the top 6 inches of weathered bedrock would be excavated and treated onsite or transferred to a recycling facility where it would be burned. Five year site review is included because contaminated (above EPA target levels) soils would remain onsite.

The present-worth cost of this alternative is estimated at $7,150,00 with capital costs of $6,655,000 and an annual cost O&M cost of 58,800.

2.10.4 Alternative 4 - Access Restrictions for Groundwater, Use Restrictions for Soil, Treatment and/or Disposal of Rubble Pile and Topsoil, and Groundwater Monitoring of Contaminant Migration and Attenuation

This alternative includes institutional controls which include all factors previously discussed in Alternative 2, as well as disposal and potential treatment of the rubble pile, treatment of the topsoil, and groundwater monitoring. The soil disposal option includes excavating the rubble pile and the top 6 inches native material (referred to as topsoil). Due to the difference in nature of the rubble pile and the topsoil, they will be handled separately. The

rubble pile, which likely consists only of construction debris, a non-hazardous waste, will be disposed at a municipal waste landfill without any restrictions. The topsoil which showed low levels of PAHs, will require additional characterization prior to disposal. If after further characterization the topsoil is found to be chemically impacted, it will be treated by thermal desorption. It has been assumed that the topsoil will require treatment while the rubble pile will be disposed at a municipal waste landfill. Engineering fill, imported from offsite, would be backfilled to replace topsoil.

The present-cost of this alternative is estimated at $3,161,316 with capital costs of $2,509,570 and O&M costs of $70,000.

2.10.5 Alternative 5 - Treatment and/or Disposal of Rubble, Topsoil, and Hot Spot Soils; In-Situ Biotreatment and Air Sparging of Groundwater; and Groundwater Monitoring.

This alternative includes treatment and/or disposal of the rubble pile and topsoil as described in Alternative 2. Some of the native oolite will also be excavated to provide source removal in some highly contaminated areas (i.e., hot spots). This alternative also includes in-situ biotreatment of the groundwater via air sparging at the site. Groundwater monitoring is included to monitor the effectiveness of the alternative during and after the treatment.

Bioremediation of the groundwater would be accomplished by installing air sparging wells to supply the necessary oxygen to enhance bioremediation. The air sparging wells would be installed at the perimeter of the groundwater plume, to prevent the spreading of the existing plume. The resulting rise in groundwater elevation in the vicinity of the well could be used to aid in hydraulic contaminant. Groundwater monitoring would occur both during and after biological treatment, to monitor the effectiveness of this alternative.

The present-worth of this alternative is estimated at $4,629,610 with capital costs of

$2,911,186 and annual O&M costs of $58,800.

2.11 SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

An evaluation and comparison of the alternatives are presented in Table 2-22. The comparison is based on the nine key criteria required under the National Contingency Plan and CERCLA Section 121 for use in evaluation of remedial alternatives by USEPA. The nine criteria are as follows:

TABLE 2-22

COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES FOR SITE FT-5

(Page 1 of 4)

Criteria
Alternative 1
Alternative 2
Alternative 3
Alternative 4
Alternative 5

No Action with Access
Restrictions for Access
Restrictions for Access
Restrictions for Thermal
Treatment and/or Disposal

Groundwater Monitoring
Groundwater, Use Restriction
Groundwater, Use Restrictions for
Groundwater, Use Restrictions for
of Rubble, Topsoil, and

for Soils, and
Soils, Soils, Treatment
and/or Disposal of Hot Spot Soils, In
Situ Biotreatment of

Groundwater Monitoring
Treatment of Rubble and Topsoil, and
Rubbles and Topsoil, and
Groundwater, and Groundwater

Groundwater Monitoring
Groundwater Monitoring
Monitoring

Overall Protectiveness

Human Health Protection
- Direct Contact/
Only current completed exposure
Same as Alternative 1.
Thermal treatment of rubble pile and
Same as Alternative 3.
Thermal treatment of rubble pile and
Soil Ingestion
pathway is that of base worker cutting the
topsoil permanently destroys large
topsoil and insitu biotreatment of

grass. Excess cancer risk is
percentage of PAH contamination
groundwater permanently destroys most

conservatively estimated at 1 x 10-5.
Excess cancer risk to current worker
of the PAH contamination at the site

and potential future resident is reduced
Excess cancer risk to current worker

to within acceptable levels by either
and potential future resident is expected

treatment or engineered controls.
to be insignificant after remediation.

- Groundwater Ingestion for Existing
No risk of ingesting contained
Same as Alternative 1. Same
as Alternative 1. Same as
Alternative 1. Same as
Alternative 1
Users groundwater. Groundwater beneath site
is not used as a potable water supply.

- Groundwater Ingestion for Future
Potential exists for ingestion of
Access restrictions provide protection Same
as Alternative 2. Same as
Alternative 2. Permanently
reduces risk to less than
Users
carcinogenic PAHs contaminated
against locating future wells in
1 x 106 by treating all environmental
groundwater if future residential wells
contained groundwater.
media of concern.
are located near present contamination.

Environmental Protection
Some potential exists for contamination in
Same as Alternative 1.
Reduces potential for constituents of
Same as Alternative 3.
Significantly reduces concentrations of

rubble pile, topsoil, and bedrock to reach
concern to reach groundwater.
constituents of concern in all

groundwater. Does not restrict migration
Groundwater contamination does not
environmental media of concern.
of current groundwater contamination.
appears to be migrating.

Compliance with ARARs

Chemical-Specific
Benzene was detected in a groundwater
Same as Alternative 1. Access Same
as Alternative 2. Same as
Alternative 2. Would likely
meet MCLs sooner than

sample collected from one well at a
restrictions reduce risks to human health
the other alternatives.
concentration just above state MCL of 1
until natural processes reduce benzene
æg/L. This alternative does not actively
concentration is groundwater to MCLs.
reduce concentration of benzene.

Location-Specific
The Biscayne Aquifer is a sole source
Same as Alternative 1. Same
as Alternative 1. Same as
Alternative 1. Same as
Alternative 1.
aquifer. Non-degradation policy applies.

Action-Specific
There are no section-specifics ARARs
Same as Alternative 1. TCLP
analysis of samples from rubble Same as
Alternative 3. Same as
Alternative 3.
associated with this alternative.
pile would likely meet LDRs.

TABLE 2-22

COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES FOR SITE FT-5

(Page 2 of 4)

Criteria
Alternative 1
Alternative 2
Alternative 3
Alternative 4
Alternative 5

No Action with Access
Restrictions for Access
Restrictions for Groundwater, Access
Restrictions for Thermal
Treatment and/or Disposal

Groundwater Monitoring
Groundwater, Use Restriction for Soils
Use Restrictions for Soils, Treatment
Groundwater, Use Restrictions for of
Rubble, Topsoil, and Hot Spot Soils,

and Groundwater Monitoring of
Rubble and Topsoil, and Soils,
Treatment and/or Disposal of In Situ
Biotreatment of Groundwater

Groundwater Monitoring
Rubbles and Topsoil, and
and Groundwater Monitoring

Groundwater Monitoring

Other Criteria an Guidance
There are no TCBs applicable to soil Same
as Alternative 1. Same as
Alternative 1. Same as
Alternative 1. In situ
bioremediation of bedrock and

contamination at Site Ft-5. The 17-1770
groundwater
will likely reduce the

regulations for total PAHs in groundwater

concentration
of consistent of concern

will not be met for many years.
to below
guidance levels within a few

years.

Long-Term Effectiveness and
Permanence

Magnitude of Residual Risk
- Direct Contract/
PAH contamination in soil is fairly
Current access to site is limited by normal
Same as Alternative 2. In addition, a Same
as Alternative 3. Reduce
risk is low. The concentrations
Soil Ingestion
persistent. However, current access to base
operations. Potential future access large
percentage of the PAH
of constituents of concern are

site is limited. is
limited by institutional controls. Risk
contamination is removed from the site
significantly reduced.

would be low because exposure and permanently destroyed.

pathways are eliminated.

- Groundwater Ingestion for Existing
No risk of ingesting benzene- Same
as Alternative 1. Same as
Alternative 1. Same as
Alternative 1. Same as
Alternative 1.
Users contaminated groundwater because the
groundwater is not used as potable water.

- Groundwater Ingestion for Future
Potential exists for ingestion of
Access restrictions provide protection
Same as Alternative 2. Same
as Alternative 2.
Permanently reduces risk to less than
Users
contaminated groundwater if future wells
against locating future wells in
1 x 10ø by in situ biotreatment.

are located with contaminated
contaminated zone.
groundwater.

Adequacy and Reliability of Controls
No controls over contamination. No
Future well placement controls required
Same as Alternative 2.   Same
as Alternative 2.
Hydraulic contaminant must be

reliability.   for
10 years until the contaminated
maintained during groundwater

groundwater naturally mitigates.
bioremediation.

Need for 5-Year Review   Review would be required to ensure
Same as Alternative 1.   Same as Alternative 1.   Same
as Alternative 1.   None required
adequate protection of human health and
the environment is maintained.
Concentrations of PAHs above health-
based levels for future land use scenario
would remain onsite.

TABLE 2-22

COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES FOR SITE FT-5

(Page 3 of 4)

Criteria
Alternative 1
Alternative 2
Alternative 3
Alternative 4
Alternative 5

No Action with   Access
Restrictions for   Access
Restrictions for Groundwater,   Access
Restrictions for   Thermal
Treatment and/or Disposal

Groundwater Monitoring
Groundwater, Use Restriction for Soils
Use Restrictions for Soils, Treatment

Groundwater, Use Restrictions for   of
Rubble, Topsoil, and Hot Spot Soils,

and Groundwater Monitoring   of
Rubble and Topsoil, and   Soils,
Treatment and/or Disposal of   In Situ
Biotreatment of Groundwater

Groundwater Monitoring
Rubbles and Topsoil, and
and Groundwater Monitoring

Groundwater Monitoring

Reduction of Toxicity, Mobility, or
Volume through Treatment

Amount Destroyed or Treated
None.   None.
About 60 to 80 percent of the VOCs and   Same
as Alternative 3.   Same as
Alternative 3. In addition, the

PAHs in the soils is expected to be
majority of the VOCs and BNAs in the

removed from the site and destroyed by
aquifer materials and groundwater are

thermal desorption.
expected to be removed and destroyed

but the in situ bioremediation.

Reduction of Toxicity, Mobility, or
None.   None.
Toxicity and volume of contaminants in   Same
as Alternative 3.
Toxicity and volume of contaminants in
Volume
rubble and topsoil reduced.
all soils and groundwater reduced.

Irreversible Treatment
Not applicable.   Not
applicable.
Thermal desorption permanently   Same
as Alternative 3.   Thermal
desorption permanently

removes VOCs and BNAs from topsoil
removes VOCs and BNAs from topsoil.

In situ bioremediation of groundwater

permanently destroys the oxidizable

organics.

Type and Quality of Residents
Not applicable. Not
applicable.
Treated topsoil is suitable for Same
as Alternative 3. Treated
topsoil is suitable for
Remaining after Treatment
replacement, road base, asphalt
replacement, road base, asphalt

batching, etc.
batching, etc. Residual nitrates and

other bioresiduals may be left in the

groundwater.

Short-Term Effectiveness

Community Protection
No risk to community. Same as
Alternative 1. Same as
Alternative 1. Same as
Alternative 1. Same as
Alternative 1.

Worker Protection
No risk to workers. Same as
Alternative 1. Workers
will potentially be exposed to Same as
Alternative 1. Same as
Alternative 3.

VOCs via inhalation during excavation.

Protective clothing will eliminate

potential risk.

Environmental Impacts
None. None.
None. None.
Potential changes to aquifer during

bioremediation.

Time to Complete Action
Not Applicable. Not
Applicable.
Excavation and disposal of rubble and Same
as Alternative 3. Six
months to remove and treat rubble

topsoil could be completed within 6
and topsoil. About 2 years to treat

months. Natural attenuation of
bedrock and groundwater.

chemicals in groundwater to below state

and Federal MCLs could take 1 to 5

years.

TABLE 2-22

COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES FOR SITE FT-5

(Page 4 of 4)

Criteria
Alternative 1
Alternative 2
Alternative 3
Alternative 4
Alternative 5

No Action with Access
Restrictions for Access
Restrictions for Access
Restrictions for Thermal
Treatment and/or Disposal

Groundwater Monitoring
Groundwater, Use Restriction
Groundwater, Use Restrictions for
Groundwater, Use Restrictions for
of Rubble, Topsoil, and

for Soils, and

Soils, Soils, Treatment
and/or Disposal of Hot Spot Soils, In
Situ Biotreatment of

Groundwater Monitoring
Treatment of Rubble and Topsoil, and
Rubbles and Topsoil, and
Groundwater, and Groundwater

Groundwater Monitoring
Groundwater Monitoring
Monitoring

Implementability

Ability to Construct and Operate
Not Applicable.
Access and restrictions require
Excavation and transportation of rubble
Same as Alternative 3.
Construction and operation of in situ

cooperation of local regulatory agencies. and
soils is easily implementable.
biotreatment system as moderately

difficult to implement. Hydraulic

control must be established. Laboratory

studies, treatability study, and modeling

is required before final design.

Flexibility of Action
Not Applicable. The
type and duration of access and use The
volume and type of soil excavated Same as
Alternative 3. System can be
designed to allow some

restrictions can be relatively easily and
treated is easily changed. On-site
flexibility in the type and amount of

modified. or
off-site treatment units are available
nutrients applied to the ground. Some

flexibility can be designed into the air

sparging system.

Ability to Monitor Effectiveness
Propped monitoring will provide notice
Same as Alternative 1. Same
as Alternative 1. Same as
Alternative 1. Same as
Alternative 1.
before significant exposure occurs.

Ability to Obtain Approvals
No approvals necessary
Same as Alternative 1. Same
as Alternative 1. Same as
Alternative 1. Same as
Alternative 1.

Availability of Services, Equipment, and
No special services, equipment, or
Same as Alternative 1.
Conventional excavation and
Same as Alternative 3. In
situ biotreatment system requires
Materials
materials required.
transportation equipment readily
specialists to install, operate, and

available.
monitor.

Availability of Technologies None required.
None required. Thermal desorption is readily available.
Same as Alternative 3. Vendors available.

Cost

Capital Cost
$27,000
$55,000 $6.7
million $2.5
million $2.9
million

Annual O&M Costs
$29,500-58,800
$29,500-58,800
$58,800
$70,000
$58,800-265,200

Present Worth Cost
$522,000
$330,000 $7.2
million $3.2
million $4.7
million

Overall protection of human health and the environment.
Compliance with Applicable or Relevant and Appropriate Requirements.
Long-term effectiveness and permanence.
Reduction of toxicity, mobility, or volume.
Short-term effectiveness.
Implementability.
Cost.
State acceptance.
Community acceptance.

2.11.1 Overall Protection of Human Health and Environment

Alternative 1 does not reduce the potential excess cancer risk to humans, nor does it provide adequate protection to environment. Alternative 2 utilizes institutional controls to prevent exposure to contaminated soils/bedrock and groundwater which reduces the potential excess cancer risk, while providing limited protection the environment via natural attenuation. Alternatives 3 and 4 significantly reduce the mass of contaminants in the rubble and topsoil, which decreases the mass of constituents of potential concern in the soil which could reach the groundwater, and implements institutional controls to prevent access to constituents of potential concern until natural processes decrease the concentrations to below health based levels of concern. These alternatives provide some environmental protection by eliminating primary source of COCs. Alternative 5 reduces the potential excess cancer risk to adults and children by destroying the organic constituents of concern in both soil and groundwater. This alternative also provides protection to the environment by treating both media of concern.

2.11.2 Compliance with ARARS

The important ARARs applicable at Site FT-5 are the state and federal MCLs and the nondegradient policy for groundwaters of the state. Alternatives 1, 2, 3 and 4 do not actively provide for groundwater treatment. It is expected that Alternatives 1 and 2 will meet ARARs within 2 to 5 years because the benzene in the groundwater is expected to naturally attenuate within that time frame. Similarly, the limited presence of PAHs in groundwater at Site (detected at 1.5 times the MCL of 10 æg/L in one sample) would also continue to naturally attenuate. As discussed in Section 2.6.2.4, PAH concentrations in groundwater showed

and 4 will result in accelerated attenuation of the COCs in the groundwater. Alternative 5 (off-site thermal treatment and in-situ biotreatment) actively treats the groundwater; the concentrations of benzene is expected to decrease to below detection limits fairly rapidly (within 1 year).

Alternatives 3 and 4 permanently destroy the constituents of concern in the rubble and topsoil. Alternative 5 permanently destroys the constituents of concern in the rubble, topsoil, bedrock, and groundwater.

2.11.4 Reduction of Mobility, Toxicity, or Volume Through Treatment

Alternatives 3 and 4 permanently reduce the toxicity and volume of the constituents of concern in the rubble and topsoil, as well as reducing the mass of COCs that are mobilized into the groundwater. Alternative 5 (off-site thermal treatment and in-situ biotreatment) permanently reduces the toxicity and volume of the constituents of concern in the rubble, topsoil, weathered bedrock, and groundwater.

2.11.5 Short-Term Effectiveness

None of the remedial alternatives are expected to cause significant risk to the community or workers during construction and implementation. Alternatives 1 and 2 will meet ARARs within 2 to 5 years, while Alternatives 3 and 4 will result in accelerated attenuation; and Alternative 5 actively treats groundwater. Alternative 5 is expected to reduce groundwater benzene concentrations to below detection limits within 1 year. There is essentially no significant environmental impact from any of the alternatives.

2.11.6 Implementability

Alternatives 1, 2, 3, and 4 are easily implementable. The in-situ biotreatment in Alternative 5 requires laboratory tests and a treatability test before final design. In addition, computer modeling must be performed during design to determine the optimum air sparging system capable of maintaining hydraulic control. Pilot-scale testing is also recommended to determine the optimal system configuration and potential adverse effects (such as well and aquifer clogging).

2.11.7 Cost

Alternatives 1 and 2 are the least costly alternatives with present worths estimated at $522,000 and $330,000, respectively. Alternative 2 assumes groundwater monitoring would be performed semi-annually for two years and would have the additional administrative costs associated with establishing the institutional controls. Alternative 3, which includes treatment of the rubble and topsoil, costs approximately $7.2 million to implement and results in a significant reduction of the contamination at the site. Alternative 4 (similar to Alternative 3 but disposal of rubble and treated topsoil is to a municipal landfill) costs approximately $3.2 million to implement, and also results in a significant reduction of contamination at the site. Alternative 5, which includes disposal and/or thermal treatment of the rubble and topsoil and in-situ biotreatment of the bedrock and groundwater costs approximately $4.7 million to implement.

2.12 SELECTED REMEDY

Based upon consideration of the requirements of CERCLA, the detailed evaluation of the alternatives and public comments, the U.S. Air Force in concurrence with the USEPA and the State of Florida has determined that Alternative 2 - Access Restriction for Groundwater, Use Restriction for Soil, and Groundwater Monitoring of Contaminant Migration and Attenuation is the most appropriate course of action for Site FT-5/OU- 1.

This alternative would achieve substantial risk reduction by controlling human exposure to contaminants. The groundwater will be monitored semiannually for two years to assess the migration and/or attenuation of contaminants. At the five year review, EPA, FDEP, and the USAF will evaluate the need for further action. This alternative would be protective, cost-effective, and would attain all Federal and State requirements. The selected remedy has been accepted by the state and community concerns have been addressed in the "Responsiveness Summary" of this ROD.

The present-worth cost of this alternative is estimated at $330,000 with capital costs of $55,000 and an annual O&M cost of $58,800.

In accordance with CERCLA requirements for sites where contaminants remain in place above EPA Target Levels, five year reviews of the site will be performed. If after the five year review, the selected remedy has not effectively reduced contaminant levels to a quality that assures protection of human health and the environment, the EPA, FDEP, and Air Force will evaluate the need for further action.

2.13 STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment as required by Section 121 of CERCLA. Existing or potential risks from exposure to soils and groundwater are reduced and controlled through access restriction for groundwater use restrictions for soils, and groundwater monitoring.

The selected remedy is expected to meet ARARs within 2 to 5 years because the benzene in the groundwater is expected to naturally attenuate within that timeframe. Similarly, the limited presence of PAHs in groundwater at Site FT-5 would also continue to naturally attenuate.

Under current land use conditions, the COCs in the soil and groundwater pose an acceptable risk to humans. Access restrictions would ensure that future exposure pathways for future residents are not completed under this alternative.

Monitoring, maintenance, and control would be required under this alternative because the contaminated soil would remain onsite and COCs in groundwater may remain above health-based levels for many years.

This Alternative utilizes institutional controls to prevent exposure to contaminated soils/bedrock and groundwater. The effectiveness of this alternative is subject to 5-year site review.

This alternative does not actively reduce the mobility, toxicity, or volume of the COCs in the soil or groundwater.

Cooperation between the USAF, USEPA, FDEP, and Dade County would be required to enact the access and use restriction.

The selected remedy is cost effective because it has been determined to provide overall effectiveness proportioned to its costs. The present net worth is estimated at $330,000.

Neither Permanent Solutions nor alternative treatments were employed at this site due to the minimal risks associated with the COCs present and the unlikely scenario of residential development as well as associated costs for removal of site contaminants. The statutory preference for treatment as a Principal Element is not met. However, use restrictions would limit exposure until concentrations of COCs are below levels of concern.

2.14 DOCUMENTATION OF SIGNIFICANT CHANGES

The PP was released for public comment on November 1, 1994. The PP identified Alternative 2, Access Restriction for Groundwater, Use Restriction for Soil, and Groundwater Monitoring of Contaminant Migration and Attenuation, as the preferred alternative for remedial action at Site FT-5/OU-1. Alternative 5 of the ROD (listed as Alternative 7 of the September 1994 Final Feasibility Study Report) was excluded from the November 7, 1994 Proposed Plan. The public was provided an opportunity for comment on this alternative upon its inclusion in the ROD. Incorporation of his alternative is not considered a significant change.

Alternative 3 of the ROD is a slight modification of the September 1994 Feasibility Study's Alternative 4, and was presented under the nine-point criteria evaluation in the Proposal Plan and ROD.

Responses to comments received during the November-December 1994 public comment period are presented in the attached Responsiveness Summary. The public comment period was reopened for thirty days (from March 14, 1995 to April 12, 1995) to provide the public with an opportunity to comment on the addition of Alternative 5. A public notice was placed in the South Dade News Leader on March 14, 1995, informing the public of the re-opening of the public comment period for OU-1. No comments were received during this second public comment period.

Homestead Air Reserve Base, Florida
Operable Unit No. 1
Site FT-5, Fire Protection Training Area No. 2

Responsiveness Summary for thee
Record of Decision

RESPONSIVE SUMMARY

FOR THE

RECORD OF DECISION

The responsiveness summary serves three purposes. First, it provides regulators with information about the community preferences regarding both th remedial alternatives and general concerns about Operable Unit No. 1, Homestead ARB. Second, the responsiveness summary documents how public comments have been considered and integrated into the decision making process. Third, it provides EPA with the opportunity to respond to each comment submitted by the public on the record.

The Remedial Investigation/Baseline Risk Assessment Report and the Proposed Plan for Homestead ARB Site FT-5/OU-1 were released to the public in April and November of 1994, respectively. These documents were made available to the public in both the administrative record and an information repository maintained at the Miami-Dade Community College Library.

A public comment period was held from November 8, 1994 to December 23, 1994, as part of the community relations plan of Operable Unit 1. Additionally, a public meeting was held on Tuesday, November 29, 1994, at 7:00 pm, at South Dade High School. A public notice was published in the Miami Herald and the South Dade News Leader on Tuesday, November 22, 1994. At this meeting, the USAF, in coordination with EPA Region IV, FDEP, and DERM were prepared to discuss the investigation, results of the Baseline Risk Assessment, and the Preferred Alternative described in the Proposed Plan.

A second public comment period was opened for thirty days from March 14, 1995 to April 12, 1995. This comment period was reopened to provide the public with an opportunity to comment on the addition of Alternative 5 to the Record of Decision. No comments were received during the second 30-day public comment period.

Summary of Comments Received During The Public Comment Period

Comments received during November-December 1994 public comment period and November 29, 1994 public meeting are summarized below. No comments were received during the second (March-April 1995) public comment period.

Comment: The Tropical Audubon Society would liked to raise several concerns about the redevelopment plans for Homestead Air Force Base.

First, there are serious pollution control concerns. Redevelopment of the Air Force Base may include several public and private organizations doing work much like what Air Force did at the base. That is, the same hazardous wastes of aviation and related industry may be in use - complicated by the new regulatory job watching multiple polluters. Damage to fuel storage tanks at the base during Hurricane Andrew suggests risk of developing anything other than clean industry in a potential hurricane path, especially on a wetlands site. New construction runs the risks of stirring up pollution sites created in the past and building land structures that change erosion patterns and cause pollutants to leach out of pollution sites.

Secondly, there are concerns about the integrity of the ecological setting. Any development should preserve mangrove stands along the canals, preserve habitats for species affected by land use changes and pollution, and preserve wilderness features in a bulk fuel storage site and fuel pump houses.

There is groundwater contamination at least in a bulk fuel storage site and at fuel pump houses.

Pollutants - including DDT and other pesticides, metals, polycyclic aromatic hydrocarbons - are at potentially harmful levels in surface water, sediment, and fist at the base canals particularly the Boundary Canal.

Response: Redevelopment of Homestead Air Force Base is currently underway and includes approximately one-third of the base having been transferred to the 482and Fighter Wing (Air Reserve) and the remaining two-thirds transferred to the Air Force Base Conversion Agency (AFBCA) for transfer of the property. The AFBCA has conducted a screening process to allow federal, state, and other eligible parties to submit expressions of interest for reuse of the property. Redevelopment of the base will include aviation activities due to the mission of the 482nd Reserve Fighter Wing. Public and private interests which may ultimately reside on the base will be required to comply with the same environmental laws and regulations as other related industry in the state of Florida.

Disposal and reuse of Homestead ARB is intimately linked to the environmental investigations, restoration, and compliance activities which are currently being carried out in accordance with state and federal regulations. Sites which have been identified as being contaminated are being scheduled for remedial action and/or being restricted for future use and development. Homestead ARB has been actively investigating potential sources of contamination at the base since 1982. An extensive parameter list of target compounds has been analyzed for in a variety of media ranging from soil/rock, groundwater, surface water, and sediments, in order to determine the impacts of contaminants on human health and the environment. Cleanup and closure of the various sites are being conducted under the guidance of the USEPA-Region IV and the state of Florida. HARB has identified the base canal systems as OU-9 which presently encompasses the Boundary Canal and many of the interior canals at the base are presently being evaluated in accordance with CERCLA.

The objectives of HARBs environmental restoration program, as defined in the BRAC Cleanup Plan, are to:

Address areas of concern that were a result of Hurricane Andrew.

Reconstruct the resources and facilities required to go forward with an effective environmental restoration program such as files, reports, buildings, etc.

Protect human health and the environment.

Comply with existing statutes and regulations.

Meet new commitments specified in the revised Federal Facilities Agreement (FFA) and consent agreements with the FDEP.

Complete RIs as soon as practicable for each OU or other IRP site.

Identify all potential source areas.

Establish areas of no suspected contamination.

Initiate removal actions, where necessary, to control, eliminate, or reduce risk to manageable levels.

Characterize risks associated with releases of hazardous substances, pollutants, contaminants, or hazardous wastes.

Develop, screen, and select remedial actions (RAs) that reduce risk in a manner consistent with statutory requirements.

Commence with RAs for the IRP sites as practicable, with special consideration for the impacts of the Everglades and the Biscayne Bay ecosystems.

The base has undergone an extensive survey of sensitive habitats, wetlands, and identification of threatened and endangered species which are known to periodically or permanently inhabit the base. No special designation species were identified at Site FT-5/OU-1. Furthermore, previous usage of the site has rendered it in a developed, no longer natural condition such that the site is predominated by weedy species.

Groundwater contamination has been identified at various locations throughout the base including the bulk fuel storage area and the fuel pump houses. These sites are actively being evaluated for remedial action and/or groundwater monitoring to limit the exposure to human health and the environment. These petroleum contaminated sites are being evaluated in accordance with the Florida Department if Environmental Protection, Petroleum Contaminated Site Criteria Section 62-770 (formerly 17-770) Florida Administrative Code (FAC).

Comment: In the technical report on the fire training area, no mention was made as to the presence of metal associated with aircraft (aluminum, magnesium, etc.), found in the top soil. An aircraft fuselage was used at the site for fire training purposes.

Response: Field investigations have been performed at OU-1 from 1984 to 1993 in order to identify the nature and extent of contamination as a result of past practices. Numerous soil and groundwater samples have been collected and analyzed for volatile organic compounds, base neutral and acid extractable compounds, inorganic metals, cyanide, and pesticides/PCBs. A regulatory review of the contaminant levels indicated that total PAHs and benzene exceeded state and federal levels in one well. No metals were found above health-based levels. Furthermore, a baseline risk assessment was performed in which the

risks to potential receptors were quantified. The risk for both current and potential future land use scenarios were above levels considered protective of human health and the environment by USEPA and FDEP. Seven remedial alternatives were evaluated based on the COC in accordance with the CERCLA screening procedures and a preferred alternative selected. This information is documented in the administrative record and available for public inspection.

Comment: Suggest the rubble pile be removed and contaminated soil be cleaned up and disposed.

Response: Seven remedial alternatives, including disposal of the rubble pile and top soil, were evaluated based on the chemicals and media of concern. These seven alternatives were screened based on the criteria of effectiveness, implementability, and cost. Four of the most promising alternatives were then carried forward and even further evaluated against the nine criteria of CERCLA. Factors concerning the disposal of the rubble pile include long term liability and disposal costs. The selected alternative (Access restriction for soil and groundwater monitoring of contaminant migration and attenuation) does achieve substantial risk reduction by controlling exposure by human contact and provides for groundwater monitoring to assess the migration and attenuation of contaminants.

Comment: I'm not pleased that the site would be only checked for 5 years. The rate of movement is unknown and what if it will not go away for 50 years or more.

Response: Based on the knowledge of the site contaminants, it is believed that the concentrations of benzene and PAHs will naturally decrease (attenuate) below levels of concern within this timeframe. In addition, long-term monitoring, maintenance, and control would be required due to the fact that contaminants will remain on site. A review of the site will continue at least every 5 years or until the levels of contaminants are at levels considered protective of human health and the environment.

Comment: It would cost less to clean the site today than 5 - 10 or 30 years from now. We really need to look more to the future that we have to the past.

Response: The USAF, USEPA, and FDEP have analyzed the alternatives and identified key trade-offs among them. Furthermore, the long term effectiveness and related considerations were evaluated. Based on a review of these factors the Base Closure Team has determined that access restriction for soil and groundwater monitoring of contaminant migration and attenuation is the most appropriate method of remedial action for this site.

Comment: The BRAC Committee EPA RI/BRA should clean the area in question up. In five years the chemicals could spread. Please save our neighborhood and family.

Response: The key elements to satisfy CERCLA remedial action include overall protection of human health and the environment, compliance with state and federal regulations, long-term effectiveness and permanence, reduction of mobility, toxicity, or volume through treatment, short-term effectiveness, implementability, cost, state acceptance, and community acceptance. Access restrictions reduce the level of exposure to humans and groundwater monitoring will assess the migration and attenuation of contaminants. With the flat groundwater gradient at the base, contaminants are not expected to migrate off site. However, the monitoring program, will track the rate of migration and contaminant concentrations and if corrective measures are required, they could be implemented to reduce the threat to human health and the environment due to migration.

RECORD OF DECISION BRIEFING
OPERABLE UNIT NO. 4, MOTOR POOL OIL LEAK AREA
HOMESTEAD AIR RESERVE BASE, FLORIDA

Operable Unit No. 4, identified as the Motor Pool Oil Leak Area, is located in the west central portion of Homestead Air Reserve Base (formerly Homestead Air Force Base). The Motor Pool is primarily used for cleaning, servicing and repairing utility vehicles. In operation since the Base was reactivated in the

1950's, the Motor Pool Area is mostly asphalt covered and surrounded on all four sides by a drainage ditch system. The selected remedy includes institutional controls, including access restrictions groundwater beneath the unit; deed restrictions limiting the use of the property of schools, playgrounds and hospitals from being built at the site; and groundwater monitoring. This remedial action is protective of human health and the environment, complies with Federal and State requirements that are legally applicable or relevant and appropriate to the remedial action and is cost effective.

<IMG SRC 0495250H> UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IV

345 COURTLAND STREET, N.E.
ATLANTA, GEORGIA 30365
SEP 7 1995

4WD-FFB

Certified Mail
Return Receipt Requested

Mr. Alan K. Olsen
AFBCA/DR
1400 Key Boulevard
Arlington, Virginia

SUBJ: Record of Decision for Operable Unit 1
Fire Protection Training Area No. 2
Homestead Air Force Base NPL Site
Homestead Air Reserve Base, Florida

Dear Mr. Olsen:

The U.S. Environmental Protection Agency (EPA) Region IV has reviewed the above referenced decision document and concurs with the selected final remedy for remedial action at Operable Unit Operable Unit 1, Fire Protection Training Area No. 2, as supported by the previously completed Remedial Investigation, Baseline Risk Assessment and Feasibility Study Reports.

The selected remedy includes institutional controls, including access restrictions that would prevent placement of potable wells in the contaminated groundwater beneath the unit; deed restrictions limiting the use of the property to non-residential dwelling purposes, including the prevention of schools, playgrounds and hospitals from being built at the site; and groundwater monitoring. This remedial action is protective of human health and the environment, complies with Federal and

State requirements that are legally applicable or relevant and appropriate to the remedial action and is cost effective.

Printed on Recycled Paper

It is understood that the selected remedy for Operable Unit-1 is the final remedial action to address all media potentially affected by past disposal practices at this unit.

Sincerely,

Patrick M. Tobin
Deputy Regional Administrator

cc: Mary Bridgewater, AFBCA
Capt. Ed Miller, AFCEE
Robert Johns, DERM
Glenn Kaden, AFCEE c/o AFBCA/OL-Y
Eric Nuzie, FDEP
Humberto Rivero, AFBCA/OL-Y (Homestead Air Reserve Base)